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REPORT
100-110

NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT FOR FISCAL YEAR 1988

MAY 28, 1987.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. ROE, from the Committee on Science, Space, and Technology, submitted the following

REPORT

together with

MINORITY VIEWS AND AN ADDITIONAL VIEW

[To accompany H.R. 2330]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 2330) to authorize appropriations to the National Science Foundation for the fiscal year 1988, and for other purposes, having considered the same, report favorably thereon with amendments and recommend that the bill as amended do pass.

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The amendments (stated in terms of the page and line numbers of the introduced bill) are as follows:

Page 2, after line 15, insert the following new paragraph:

> (1) the amounts authorized in subsection (a) shall be available for unique advanced computing resources in support of research needs;

Page 2, line 16, strike "(1)" and insert "(2)".
Page 2, line 19, strike "(2)" and insert "(3)".
Page 3, line 7, strike "(3)" and insert "(4)".
Page 6, after line 26, insert the following new section:

REPORT ON SOVIET EFFORTS TO COMPROMISE U.S. CIVILIAN RESEARCH PROGRAMS

> SEC. 11. The Director shall, in cooperation with the National Security Council, submit by December 31, 1988, to the House Committee on Science, Space, and Technology and the Senate Committee on Labor and Human Resources, a report detailing Soviet efforts to penetrate, utilize, and compromise the civilian science research programs of the United States.

Page 6, after line 26, insert the following new section:

NSF BOARD MEETINGS

> SEC. 12. Section 4 of the National Science Foundation Act of 1950 (42 U.S.C. 1863) is amended by adding at the end the following new subsection:
>
> "(k) Portions of Board meetings in which the Board considers possible Foundation budgets for a particular fiscal year that might be submitted to the Congress may be closed to the public until the President's budget for that fiscal year has been submitted to the Congress.".

Page 7, line 2, strike "11" and insert "13".

I. SUMMARY

BUDGET ACTIONS

Budget Total

The President's budget included a request for $1,893,000,000 for the National Science Foundation (NSF) in fiscal year 1988 in new obligation authority. The Committee maintained the level of the Administration's request but redirected $25,000,000 from the U.S. Antarctic Program and a total of $13,500,000 from the Directorates for Mathematics and Physical Sciences; Engineering; Biological, Behavioral and Social Sciences; and Geosciences. Of the total of $38,500,000 which was redirected, $35,000,000 was transferred to the Science and Engineering Education Directorate and $3,500,000 was transferred to the Computer and Information Science and Engineering Directorate.

H.R. 2330 as reported includes the provision that, of the funds authorized, not less than $48,500,000 is authorized only for purposes of funding NSF Supercomputer Centers within the Computer and Information Science and Engineering Directorate. In addition, the bill states that not less than $56,000,000 is authorized only for purposes of Teacher Preparation and Enhancement activities (and of this amount $42,000,000 is directed for precollege Teacher Enhancement activities), not less than $39,000,000 is authorized only for purposes of Materials Development and Informal Science Education and not less than $11,500,000 is authorized only for purposes of the College Science Instrumentation Program, all within the Science and Engineering Education Directorate.

H.R. 2330 as reported requires that 50 percent of all funds authorized for the Engineering Directorate which are allocated for creating New Enginering Research Center be used for Centers that focus on research relating to manufacturing technologies. Also, from that portion of the total authorization which NSF designates for establishing Science and Technology Centers, the bill requires that sufficient funds be set aside to create at least one Center dedicated to the development of model curriculum relevant to instruction in two-year and community colleges.

OTHER ACTIONS

(A) The bill as reported by the Committee amends the National Science Foundation Act of 1950 as follows:

(1) To remove the requirements that NSF fellowship awardees take a loyalty oath and report on any past criminal record.

(2) To permit the National Science Board to close to the public portions of Board meetings which are devoted to consideration of NSF budget which have not been submitted to Congress.

(B) The bill as reported by the Committee encourages the Directorates of Biological, Behavioral and Social Sciences and Geosciences to support improvements in research facilities at U.S. marine biological laboratories.

(C) The bill as reported by the Committee permits funds from any of the NSF Directorates to be used for unique advanced computing resources in support of research needs.

(D) The bill as reported by the Committee requires that the following reports be provided by NSF:

(1) A report on all funds expended on undergraduate science and engineering education programs at NSF.

(2) A report on science and technology programs in two-years and community colleges.

(3) A report on the impact of salary levels on retention and recruitment of precollege science and mathematics teachers.

(4) A report detailing Soviet efforts to penetrate, utilize, and compromise the products of the civilian science research programs of the United States.

(E) Additional concerns and views of the Committee are reflected in the Committee Views section of this report.

PURPOSE OF THE BILL

The purpose of the Bill is to authorize appropriations to the National Science Foundation for fiscal year 1988 in the amount of $1,893,000,000 out of money in the Treasury not otherwise appropriated as follows:

Budget activities—authorization, fiscal year 1988

Research and related activities:	
Biological, Behavioral and Social Sciences	$294,000,000
Computer and Information Science and Engineering	146,500,000
Engineering	202,900,000
Geosciences	326,700,000
Mathematical and Physical Sciences	508,900,000
Scientific, Technological and International Affairs	51,000,000
Program Development and Management	95,000,000
Science and Engineering Education	150,000,000
U.S. Antarctic Program	118,000,000
Total	1,893,000,000

NATIONAL SCIENCE FOUNDATION BUDGET COMPARISONS: ACTIONS BY THE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

[Authorization in millions of dollars][1]

Activities	Current FY 1987	Administration request FY 1988	Committee recommendation (H.R. 2330)	Changes from administration request
Research and Related Activities:				
Biological, Behavioral and Social Sciences	258.0	297.0	294.0	−3.0
Computer and Information Science and Engineering	116.0	143.0	146.5	+3.5
Engineering	163.0	205.0	202.9	−2.1
Geosciences	285.0	330.0	326.7	−3.3
Mathematical and Physical Sciences	463.0	514.0	508.9	−5.1
Scientific, Technological and International Affairs	44.0	51.0	51.0	0.0
Program Development and Management	77.0	95.0	95.0	0.0
Subtotal, Research and Related Activities	1406.0	1635.0	1625.0	−10.0
Science and Engineering Education	99.0	115.0	150.0	+35.0
U.S. Antarctic Program	117.0	143.0	118.0	−25.0
Special Foreign Currency	0.7	0.0	0.0	0.0
Total	1623.0	1893.0	1893.0	0.0

[1] Dollar amounts have been rounded.

II. EXPLANATION OF COMMITTEE AMENDMENTS TO H.R. 2330

The Committee adopted three amendments to H.R. 2330 which are printed at the beginning of this report and which comprise sections 2(b)(1), 11 and 12 of the printed bill.

EXPLANATION

The Committee adopted amendments which:

(1) Requires that funds authorized in section 2(a) be available for providing unique advanced computing resources in support of research needs. Further explanation is contained in the Committee Views.

(2) Requires that the Director of the Foundation in cooperation with the National Security Council submit by December 31, 1988 a report to Congress detailing Soviet efforts to penetrate, utilize, and compromise the civilian science research programs of the U.S.

(3) Amends section 11 of the National Science Foundation Act of 1950 to permit the National Science Board to close to the public portions of Board meetings which are devoted to consideration of NSF budgets which have not been submitted to Congress.

III. SECTIONAL ANALYSIS OF THE BILL, H.R. 2330

A bill to authorize appropriations for activities of the National Science Foundation (NSF) for fiscal year 1988.

Section 2(a).—Authorizes appropriations to NSF for fiscal year 1988, in the following categories:

1. Biological, Behavioral and Social Sciences	$294,000,000
2. Computer and Information Science and Engineering	146,500,000
3. Engineering	202,900,000
4. Geosciences	326,700,000
5. Mathematical and Physical Sciences	508,900,000
6. Scientific, Technological and International Affairs	51,000,000
7. Program Development and Management	95,000,000
8. Science and Engineering Education	150,000,000
9. United States Antarctic Program	118,000,000

Section 2(b).—Requires that from the amounts authorized under subsection (a): funds shall be available to provide unique advanced computing resources in support of research needs; not less than $56,000,000 is authorized only for the purposes of Teacher Preparation and Enhancement activities (at least $42,000,000 of which is for precollege programs); not less than $39,000,000 is authorized only for purposes of Materials Development and Informal Science Education; not less than $11,500,000 is authorized only for purposes of the College Science Instrumentation Program; and emphasis should be placed on improvements in the research facilities at U.S. marine biological laboratories.

Section 2(c).—Requires that 50 percent of all funds authorized for the NSF Engineering Directorate which are allocated for creating new Engineering Research Centers are used for Centers that focus on research relating to manufacturing technologies.

Section 3.—Makes appropriations under authority provided in section 2 available for obligation for time periods specified in the appropriations bill.

Section 4.—Authorizes up to $7,500 for official consultation, representation, or other extraordinary expenses at the discretion of the Director of NSF.

Section 5(a).—Permits transfer of funds between categories in section 2, up to 10 percent of the amounts authorized in those categories.

Section 5(b).—Permits the Director to transfer funds between the categories in section 2 exceeding 10 percent of the amounts authorized in those categories, provided an explanation of any such proposed transfer is transmitted in writing to the appropriate authorizing Committees of the House and Senate, and 30 calendar days have passed after the transmission of such explanation.

Section 6.—Requires that the Director submit by January 15th of each year a report to Congress on the programs funded by the Foundation which support undergraduate science and engineering education. The report must provide funding levels and program descriptions broken out by NSF directorate, provide information on the geographic distribution of awards, and provide a breakout of awards by type of institution funded.

Section 7.—Requires that at least one of the new Science and Technology Centers which NSF has proposed to create in fiscal year 1988 be dedicated to the study of information technology and development of model curriculum relevant to instruction in two-year and community colleges.

Section 8.—Requires that the Director submit by January 1, 1988 a report to Committees of the House and Senate on the state of science, technology and engineering programs in U.S. two-year and community colleges. The report must provide an assessment of current programs, a description of deficiencies, cost estimates for remedying deficiencies, and recommendations for programs NSF could institute or expand to remedy deficiencies.

Section 9.—Requires that two-year and community colleges be eligible to participate in all NSF programs which address undergraduate science and engineering education.

Section 10.—Requires that the Director submit by November 1, 1988 a report to Committees of the House and Senate on the impact of salary levels on the recruitment and retention of science and mathematics teachers at precollege levels throughout the U.S.

Section 11.—Requires that the Director, in cooperation with the National Security Council, submit by December 31, 1988 a report to Congress detailing Soviet efforts to penetrate, utilize, and compromise the civilian scientific research programs of the U.S.

Section 12.—Amends section 4 of the National Science Foundation Act to permit the National Science Board to close to the public portions of Board meetings which are devoted to consideration of NSF budgets which have not been submitted to Congress.

Section 13.—Repeals section 15(c) of the National Science Foundation Act. This action deletes an obsolete provision having no current effect and also deletes the requirement, which has no counterpart in student aid programs in other federal agencies, for an oath and for reporting past criminal records in NSF fellowship applications.

IV. Committee Views

THE NATIONAL SCIENCE FOUNDATION AND COMPETITIVENESS

Committee view

The National Science Foundation (NSF) plays a central role in the support of basic science and engineering research in U.S. universities and also in the training of future generations of scientists and engineers. This role encompasses generating new knowledge and helping sustain a highly trained workforce to exploit new technologies spawned by this new knowledge. The Committee believes that the future economic vitality and competitiveness of the U.S. in the world marketplace will ultimately depend on the strength of the Nation's science and technology base. Basic scientific research and the education of scientists and engineers create this base for technological advances. History has shown that a sustained investment in basic research contributes to economic growth, to an improved quality of life and to enhanced national defense capabilities.

The Committee supports and endorses the Administration's proposal of doubling the NSF budget within the next five years. This proposal is consistent with the Committee's firm belief in the importance of NSF's contribution to the Nation's well-being. Despite the serious federal budget deficit, the Committee believes that the significant increase in funding the NSF is essential to address important concerns about the health of the U.S. basic research enterprise and, in particular, concerns about the state of science and engineering education. The proposed budget increase would also allow NSF to pursue new research opportunities, including interdisciplinary, multiple-investigator efforts involving linkages with industry.

U.S. economic competitiveness is ultimately tied to the availability and excellence of scientific and technical manpower. Therefore, the Committee is concerned about the decreasing fraction of American college students choosing science and engineering studies at a time when the total pool of college-aged students is declining significantly. Over the past 15 years, the proportion of the U.S. population engaged in science and engineering has declined appreciably relative to other technologically advanced nations. During the same period, the federal investment in undergraduate and precollege science education has dropped dramatically and is now at a level well below that of the 1960's in constant dollars. At a time when the U.S. must compete against strong economic rivals in a global marketplace, these trends are disquieting. The Committee believes that NSF must play a strong role in strengthening science and mathematics instruction at the precollege and undergraduate levels to ensure that the pipeline of scientists and engineers remains filled and to maintain a large, technically literate, inventive and adaptable workforce. Specific Committee actions to strengthen the science and engineering education program at NSF are described subsequently.

A critical factor in maintaining economic competitiveness is the ability of a country to bring new technologies to the marketplace rapidly. The U.S. has clearly begun to lag behind international competitors in the commercialization of new discoveries. The transfer of new scientific results from the laboratory to industry, a critical link in the commercialization process, can be accomplished most effectively through direct collaboration between individuals. The Committee applauds the efforts of NSF to help achieve this direct communication by means of new initiatives which encourage industrial participation and support, such as the Engineering Research Centers (ERC). The communication channels to be opened by the ERC's will not only facilitate transfer of new discoveries to industry but will also expose university researches to industry technology problems, which may suggest and help to define new basic research topics of relevance to industry.

In addition in industrial linkages, the Committee strongly urges NSF to facilitate linkages with our federal laboratories. The proposed NSF science and technology centers, as well as the Engineering Research Centers program, are appropriate avenues to encourage such collaboration. The NSF, and its current and future centers can benefit from the intellectual exchange and the financial investment that has gone into maintaining these facilities. There are several hundred federal laboratories receiving over $18 billion of federal R&D support and employing one-sixth of the nation's scientists and engineers. One major function of the labs is to help businesses, state and local governments, and universities to work with and use ideas from the federal laboratory system most appropriate to their areas of interest or need. Furthermore, interaction between NSF and the federal labs is consistent with a recent Executive Order #12591 on facilitating access to science and technology.

While the role of industry is important for the success of the ERC's and the proposed science and technology centers, the Committee is concerned that the influence of the industrial partners could shift the emphasis of work performed in the centers from long-term, fundamental research to applied research focused on solving near-term industrial problems. The Committee cautions NSF to be vigilant in maintaining its proper role of supporting basic research.

Balance Between Centers and Individual Grants

The Committee is aware of the advantages of science and technology centers in supporting promising interdisciplinary research, in providing access for mulitple researchers to sophisticated instrumentation and facilities, and in forging links between research universities and industry. However, the Committee also firmly believes that individual awards promote flexibility and spontaneity which often foster scientific breakthroughs. NSF must continue to nurture such creativity.

At present, the Committee understands that individual grant awards comprise a healthy sixty percent of the NSF research budget. However, the trend at NSF is to increase the number of science and technology centers each year. The Committee is concerned that these programs are being expanded rapidly before the initial centers have been reviewed and before the overall effectiveness of the centers concept has been evaluated. Moreover, the turnover process for the centers has not been demonstrated since none has yet been terminated.

The Committee believes that the success of the NSF initiative for science and technology centers will depend significantly on the review procedures established early in the program. NSF has indicated that during 1987 the reviews of the first group of ERC's will be accomplished to determine whether support will continue or be terminated over the next two years. Experience gained from this review process should facilitate formulation of a set of guidelines and criteria for use in evaluating all science and technology centers.

The Committee requests that NSF provide a report by November 1, 1987 describing the review process, criteria to be used, and schedule for evaluating science and technology centers. The Committee will be reluctant to support further expansion of the number of centers in the absence of a detailed plan which will ensure that successful centers may be identified and unsuccessful ones terminated in an orderly way.

SCIENCE AND ENGINEERING EDUCATION

Background

The United States is in a period of economic transition. The industries upon which American economic leadership was founded since World War II have slipped into a state of decline. Steel, autos, and textiles are among the ailing giants. Nations in Western Europe and the Pacific Basin outproduce the United States in manufactured goods and have overtaken our preeminent position in world trade. Simultaneous with our decline in world economic competition has been the slippage in educational instruction and student achievement. The number of qualified teachers has dropped, course content has grown out of date and irrelevant, and the level of student achievement, especially in science and mathematics, is among the world's lowest.

A new world economic picture has emerged centering around a highly productive and skilled workforce producing goods in modern workplaces utilizing the latest technical concepts. Underlying this trend are the twin pillars that support every successful world economic power: technology and technically skilled manpower. NSF is unique in that it can make a major contribution to achieving both. In the Science and Engineering Education Directorate the NSF can enhance the quality of classroom instruction that will generate the prerequisite workforce for successful world competition. Programs aimed at precollege, undergraduate, graduate, and postgraduate education constitute NSF's activities in this area. Through these programs NSF can help bring about quality instruction in science, mathematics, and engineering for every student at every level of our educational system.

Improving the quality of science, mathematics, and engineering education will require fundamental changes in both what is learned and how it is taught. Effective leadership will be required at all levels of government in order to build a new national commitment to providing quality education for all students that includes up-to-date skills in science and mathematics. Practices and attitudes in the present educational system must be significantly improved. Teaching methods, curricula, learning opportunities and the use of advanced technologies are among the elements that can improve under the leadership of the National Science Foundation. In this regard, NSF's education programs, although relatively small, can make contributions far beyond their proportional size in the federal structure.

Of special significance is the March 21, 1986 report of the National Science Board Task Committee on Undergraduate Science and Engineering Education. Chaired by Dr. Homer Neal of the State University of New York at Stony Brook, the NSB Committee examined the role played by the Foundation in undergraduate science, mathematics and engineering education. The NSB Committee found serious problems in the physical infrastructure of colleges and universities that threaten the quality of education at four-year institutions. The report included recommendations for Federal and State governments, academe, and the private sector for actions to be taken to address these problems.

Further, and most importantly, the NSB Committee asserted that the NSF should assume a leadership role in promoting the health of undergraduate education.

When the mandate to support the quality of science, mathematics, and engineering education at all levels (National Science Foundation Act of 1950) is combined with NSF's unique strengths and nationwide contacts, the Foundation has the opportunity to make a meaningful contribution toward raising the scientific literacy of all students and renewing the pool of technically skilled manpower needed to compete effectively in the world marketplace.

Committee View

In the National Science Foundation Act of 1950 science education activities were given equal partner status with scientific research activities. In its early history the NSF devoted a commensurate amount of funding to science and engineering education. Specifically, science and engineering education represented an average of thirty percent of the total NSF budget from the late 1950's through the 1960's. Since then, however, this proportion has steadily declined to the point of near extinction in fiscal years 1981 and 1982. Although this trend was reversed in recent years, science education activities now represent only six percent of the NSF budget. Further, the proposed budget for fiscal year 1988 teacher enhancement, materials development, and informal education activities recommends the same level of funding as in fiscal year 1987.

In response to these trends the Committee has increased the authorized level of funding for the Science and Engineering Education (SEE) Directorate above that proposed by the Administration. Specifically, the Committee boosted the proposed authorized funding level for the SEE Directorate from $115.0 million to $150.0 million. Within the Directorate's activities the Committee increased the Teacher Preparation and Enhancement program from the proposed level of $36.0 million up to $56.0 million (this increase is directed entirely to the teacher institute program), increased the Materials Development and Informal Education program from the proposed level of $26.0 up to $39.0 million, and increased the College Science Instrumentation Program (CSIP) from the proposed level of $9.5 million to $11.5 million. This increase for the CSIP program is in direct response to the recommendations of the Neal Report relating to instructional instrumentation.

Two-year and community colleges will be eligible for all programs addressing undergraduate science and engineering education. In support of these programs the Committee mandated that NSF undertake studies to assess the unique problems and needs of two-year and community colleges and the impact of salary levels on recruitment and retention of precollege science and mathematics teachers. In addition, the Foundation must submit each year a report on the NSF programs that support undergraduate science and engineering education. This report will outline the undergraduate programs in each Directorate of the Foundation as well as information on geographic distribution of awards and funding by type of institution.

The Committee applauds the NSF for the special initiative in undergraduate education. NSF's budget proposal set a target of $68 million for spending on undergraduate education throughout the Foundation. The Committee expects NSF to come as close to that target as appropriation levels and grant proposal quality will allow. The Committee was persuaded by NSF's arguments that the support of undergraduate science and engineering education is a programmatic responsibility of the research directorates, as well as the SEE Directorate. The performance of the research directorates in distributing this funding will be the test of those arguments. The directorates should pay particular attention to the undergraduate enterprise, including the needs of two- and four-year colleges, which have sometimes been neglected. The Committee views the NSF initiative as the beginning of a steady commitment to undergraduate education to remedy the deficiencies cited in the Neal Report. As part of NSF's activities in pursuit of this goal, the Committee expects the Office of Undergraduate Science and Engineering Education to serve as a focal point, as well as monitor and coordinate all of NSF's undergraduate activities.

With $20.0 million in additional support for the teacher institute program, the Committee expects the NSF to increase the number of teacher institutes and, as a direct result, increase the number of precollege science and mathematics teachers participating in this program. In pursuit of this goal the Committee expects the NSF to make a determined and systematic effort to ensure equitable geographic distribution of funds and teacher institutes so as to raise the quality of science and mathematics instruction in every state in the Union. Since the amount of local resources vary from state to state and region to region, the NSF should give consideration to the local resources available for teacher participation in this program in determining where the teacher institutes will be located. This will help ensure that although some areas of the country may lack local resources to support local teacher participation in these institutes they will have the opportunity to benefit from this program.

In previous years the Committee expressed its desire for innovative ways to develop science and mathematics teaching materials. The Committee commends the NSF for responding to the Committee's wishes by fostering partnerships between publishers and curriculum developers. While encouraging the NSF to continue these alliances, the Committee believes the NSF should also support the development of science and mathematics teaching materials coupled with other related activities that are created through alternative models such as partnerships between developers and other members of the private sector, universities, and state and local educational agencies. New types of alliances could include new elements that do not presently exist such as follow-up coaching of teachers, localization of materials to address local needs, adaptable materials that reflect unique education environments, preservice training in the use of new materials, ongoing research to address problems arising in the use of new materials, and other innovative uses of advanced technologies.

The Committee continues to be impressed with the growing impact of children's educational television on science and mathematics teaching and learning. NSF support for such television programs is responsible for reaching nearly five million children ages 8 to 12. Television series such as "3-2-1 Contact" and "Square One TV" are seen in both the classroom and the home. They are typical of the broad, cost-efficient outreach that NSF seeks to utilize in its programs. The Committee is aware that the matching support for the development of such programs by the Department of Education is in jeopardy. The Committee wishes to restate its strong support for children's television projects and the expectation that both the NSF and the Department of Education will cooperate in developing these programs. In general, the Committee urges the NSF to seek opportunities to work with the Department of Education on initiatives of mutual interest. Given their respective roles, the Committee suggests, for example, that the Foundation focus its efforts on the development of high quality materials while the Department of Education focuses its efforts on the dissemination of such new materials.

The Committee included a provision in H.R. 2330 designating one of the proposed science and technology centers for the development of model curricula in science and mathematics to meet the specific needs of two-year and community colleges. High quality instructional technologies and materials designed for the special needs of these institutions could significantly enhance student's abilities to pursue careers in high-technology fields and to benefit from retraining for new employment. Further, strategic and up-to-date science and mathematics curricula will improve the overall technical literacy of all students at these institutions, regardless of their future careers. This element takes on major significance in light of the fact that the majority of current freshman and sophomore college students attend two-year and community colleges. NSF is encouraged to seek the participation and support of other Federal agencies, such as the Departments of Labor and Education, and other interested participants with concern for the technical literacy of the nation's workforce.

The Committee intends that the purpose of the two-year and community college science and technology center is to develop model curricula that meet the subject matter and instructional needs of community colleges throughout the country. In a 1987 report entitled "Interdisciplinary Research in Mathematics, Science, and Technology Education" a panel of the National Research

Council pointed out that the development of new curricula and teaching methods would be an appropriate focus for multi-disciplinary research centers. The report also pointed out that multi-disciplinary centers could stimulate research, development, and applications of new curricula.

The Committee intends that the curricula should be developed on the basis of appropriate needs assessments and in consultation with two-year and community college faculty and educational leaders. The Committee also intends that the resulting educational and instructional products will incorporate the latest techniques of applying information technology in education to facilitate cost-effective and rapid replication, transfer, and interaction between curricula producers and faculty as well as between faculty and students. The Committee envisions this science and technology center as a dynamic and intensive central focus for the research and development of high quality model curricula to meet the immediate instructional needs of two-year and community colleges. Such a science and technology center would develop model curricula for the core subjects in science, engineering, and technology. Model curricula will serve as the basis upon which curricula in related fields would be developed both in association with the center as well as outside the center.

On February 10, 1987 the NSF submitted the first annual update of the five-year strategic plan for science and engineering education activities mandated in P.L. 99-159. The Committee is disappointed that neither the initial plan nor this first revision resembled a strategic plan identifying goals and associated outcomes, funding levels and timetables for activities, staffing requirements, and specific program objectives. Through such a detailed strategic plan the NSF as well as the Congress will gain an insight into the dimensions of current needs and how the NSF will address these needs in a meaningful and systematic fashion.

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Committee View

The Committee applauds the consolidation of Foundation programs in the computer and information science disciplines, as well as in advanced scientific computing and networking, in the new Computer and Information Science and Engineering Directorate. This action further emphasizes the NSF commitment to advance U.S. capabilities in these areas, which are having a strong impact on many science and engineering disciplines and which will contribute to technologies that are critical to improve economic productivity. Also, the separation of the networking programs from the advanced scientific computing subactivity within this new Directorate is viewed as a positive action. The Committee expects that this will focus management attention on establishing high speed links among supercomputer sites, as well as on the more general problems associated with establishing a national scientific information and data exchange network among universities.

NSF has now established five national supercomputer centers to provide wide access for university researchers to advanced scientific computers, to develop improved software and operating systems to maximize user productivity, and to stimulate development of more advanced supercomputers by the U.S. computer industry. For these centers to achieve their goals of maintaining both leading-edge hardware and also expert staffs, for providing user support services and for developing new supercomputing methods, the funding levels for the centers should be maintained at least at the levels negotiated in the cooperative agreements between NSF and each center. The Committee requests that NSF provide a report on the status of each NSF national supercomputer center by October 30, 1987. This report should include a description of installed supercomputer hardware, plans for hardware upgrades in fiscal year 1988, staffing levels compared with staffing plans/requirements, and funds committed compared with cooperative agreement funding levels for each fiscal year from center inception through fiscal year 1987.

The Committee strongly believes that one of the most important goals of the NSF advanced scientific computing initiative is to stimulate the development of new generations of supercomputer hardware by the U.S. computer industry. To that end, NSF should provide access for university researchers to all leading-edge, advanced scientific main-frame computers of U.S. manufacture. The Committee endorses NSF's stated policy to continually update the computer hardware at the NSF centers in order to maintain them at the leading-edge. In addition, the Committee notes that NSF has established the policy of providing support at alternative computer sites for NSF researchers whose proposals have justified the need for access to an advanced computing capability which is unavailable at an NSF national center. The Committee also notes that NSF scientific directorates may allocate research funds to support such requests for computer resources. The Committee strongly encourages NSF to disseminate this policy on computer access and support widely to the research community.

In order to assist NSF in achieving the important goals of the advanced scientific computing program, the Committee redirected $3.5 million into the Computer and Information Science and Engineering Directorate to raise the funding level of the Advanced Scientific Computing Division from $48.2 million to $51.7 million. Of this $51.7 million, the Committee directed that a minimum of $48.5 million be used for support of supercomputer centers. In addition, the Committee authorized the use of funds from any of the NSF directorates to provide unique advanced computing resources for university researchers. The Committee encourages NSF in allocating the funds available for advanced scientific computing to balance the requirement for maintaining the NSF national supercomputer centers at their cooperative agreement levels and the need to accommodate justifiable user requirements at other than NSF national centers.

The demand for access to supercomputers by the university research community is growing. New researchers are being trained to use supercomputers and significant new problems are being attacked which require large blocks of supercomputer time. This trend is reflected in the imminent user saturation of the national supercomputer centers. In order to assess user demand relative to available and projected resources, forecasts are needed for required supercomputer cycles for users in the various scientific and engineering disciplines now using supercomputers and in disciplines likely to begin using them. As part of this forecast, an analysis is needed of the nature of past supercomputer use at the NSF supercomputer centers and, in particular, of the degree to wich computer cycles supplied were for problems accessible only with supercomputers. That is, an assessment is needed of the potential role of dedicated mini-supercomputers and of mainframe computers less capable than supercomputers in providing capacity to off-load some of the demand for supercomputer cycles at the leading-edge national centers.

The Committee requests that NSF provide a report by December 1, 1987 including the following information. The report should provide a forecast of supercomputer demand for the next five years by the university research community. The report should assess the roles of dedicated mini-supercomputers, non-NSF supercomputer centers, and NSF national centers in meeting the projected demand and should address NSF plans for support of supercomputer access outside the NSF centers. The report should describe the procedure that will be used in allocating computer cycles at the NSF national centers after the user saturation point is reached. Finally, the report should provide an assessment of the impact of the NSF supercomputer centers on the conduct of research in the scientific and engineering disciplines and provide a long-range plan for the role of the centers, including a timetable for evaluating their performance and a description of the criteria to be used in the evaluations.

The Committee supports the creation of a national scientific computer network capable of supporting a full range of research and educational activities. current decisions regarding the technologies, standards and protocols will impact the future configuration of this network. To the extent that careful coordination and tight management control occur in the early stages, the task of creating a national internet becomes less daunting. The Committee believes that NSF should take a leading role in focusing and coordinating the activities of the federal agencies and private sector organizations which will be involved in establishing, maintaining and using a national scientific network. The focus achieved within NSF by formation of the new Division on Networking and Communications Research and Infrastructure should greatly assist NSF in performing this role.

In the report accompanying the NSF Authorization Act for fiscal year 1987, NSF was asked to develop a computer network management system "in the very near term." The Committee regrets that it has not received a copy of this plan. The Committee now understands that NSF has formulated and has begun to implement an overall plan which has as its goal the creation of a high capacity, high speed national research network within a decade. The Committee requests that NSF provide a description of this plan, including the interim goals and estimated timetable for achieving them by November 1, 1987. The Committee is particularly interested in NSF's assessment of user needs, current and projected technology options, deficiencies/plans for the management of a completed network, and cost estimates both for creating and for maintaining the network.

U.S. ANTARCTIC PROGRAM

Committee View

The NSF budget request for fiscal year 1988 is $143 million, an increase of $26 million or 22% over the fiscal year 1987 funding level. This $143 million breaks down to $13.5 million for the U.S. Antarctic Research Program and $129.5 million for Operations Support. The Operations Support budget includes $30.7 million for the Direct Science Support subelement, which includes costs that would not be incurred if the United States were only involved in maintaining a presence in Antarctica. Therefore, the total cost for support of Antarctic research is $44.2 million of the $143 million total.

The Committee notes that the Direct Science Support subelement of the proposed NSF budget includes a $13 million increase for the lease of an icebreaking research ship. Prior to the proposal for fiscal year 1988, NSF requirements for icebreaking ships were met by using Coast Guard vessels. In fiscal year 1987, NSF was relieved of the requirement to reimburse the Coast Guard for a portion of icebreaker fixed costs and had to reimburse only the direct operating costs of Coast Guard vessels while the NSF missions. This change resulted in a reduction of $14 million in the NSF research support costs.

The Committee realizes that the recent decommissioning of the Coast Guard icebreaker *Glacier*, which supported NSF research activities, necessitates that measures be taken for providing alternative research platforms. The Committee strongly encourages NSF to work closely with the Coast Guard and the Navy to formulate a unified position on future U.S. icebreaker requirements that incorporates the inputs of the federal agencies having mission needs for icebreakers. In light of the long lead time for designing and building icebreakers, this unified position should be arrived at as soon as possible. In addition, the Committee requests NSF to submit a report by October 1, 1987 on the relative costs and benefits associated with using Coast Guard icebreakers, using leased commercial icebreakers, or pursuing other options to support Antarctic research. The report should be prepared either in conjunction with the Coast Guard or by an independent body, such as the National Academy of Sciences.

The Committee commends the NSF's scientific research program which is carried out under the extremely difficult conditions of the Antarctic. However, the principal part of the U.S. Antarctic Program budget is not for research support, and the Committee believes that present priorities within the overall range of NSF programs do not permit a 22% increase in this part of the budget. Consequently, in order to augment important programs in science and engineering education which have been neglected in recent years, the Committee has redirected $25 million from the U.S. Antarctic Program to the Science and Engineering Education Directorate. This action effectively freezes the U.S. Antarctic Program at the fiscal year 1987 funding level.

MANUFACTURING RESEARCH

Background

During the past few years, the plight of U.S. manufacturing has become a major public policy issue. Added to the serious decline in the U.S. trade balance in traditional manufactured products has been the more recent deterioration in the U.S. share of world exports of high technology products. For example, the U.S. share of total world exports of aerospace, telecommunications, electrical components, drugs, and medical instruments has declined by 20% in the past ten years as reported in "Toward a New Era in U.S. Manufacturing," National Academy Press, 1986. The National Association of Manufacturers estimates that 70% of U.S. manufacturing is now confronted with import competition.

For the past 35 years, U.S. manufacturing output has been about 24% of GNP. A trend of slow growth stopped in about 1973; and, since then, growth has been virtually nil. The impact of any decline in the manufacturing sector is disproportional to its share of GNP. Local dislocations are inevitable. Living standards suffer since service sector jobs pay considerably less than manufacturing jobs, and also there is no guarantee that the U.S. can maintain a favorable balance of trade in services to offset imbalances in manufactured goods. Finally, maintenance of manufacturing capability is essential for national defense, particularly since the U.S. relies on technologically advanced weapons to offset quantitative imbalances with potential adversaries. High technology weapons production requires complex manufacturing processes and advanced production equipment.

New manufacturing technologies have promise for reversing these unfavorable trends in the U.S. manufacturing sector. Projected developments in computerized manufacturing automation will revolutionize the design and production strategies available to manufacturers, bringing greater adaptability to changing market conditions and reduced costs and higher quality to new products. Basic research is a prerequisite for developing the new manufacturing technologies and, thus, achieving this changed manufacturing environment. Moreover, success in this endeavor will likely prove to be essential for our long-term economic competitiveness in the international marketplace.

Committee View

The Committee recognizes that NSF has initiated programs which address important research relevant to manufacturing technologies, primarily in the Engineering and in the Computer and Information Science and Engineering Directorates. The Committee strongly supports these efforts and believes that NSF has an important long-term role in establishing the knowledge base necessary to spur the implementation of new manufacturing technologies.

To place additional emphasis on the importance of such research, the Committee has directed NSF to devote at least 50% of all funds allotted for creation of new Engineering Research Centers (ERC) to centers which focus on research relevant to new technologies both for discrete and continuous process manufacturing. NSF should encourage submittal of research proposals for new ERC's which reflect this emphasis on manufacturing research issues. The Committee expects NSF to use its usual merit review process to select all new ERC's.

NSF provides support for a significant portion of the university reseach effort in process metallurgy which is relevant to steelmaking. The Committee encourages NSF to foster interaction among the NSF supported university scientists and the scientists in federal laboratories involved in the DOE/NBS Steel Initiative. Full coordination of research plans and rapid dissemination of research results should enhance the impact of the total federal R&D effort to improve the competitiveness of the U.S. steel industry.

FACILITIES AND INSTRUMENTATION INFRASTRUCTURE

Committee View

The need to modernize deteriorating and obsolete research facilities and equipment at universities and colleges is of great importance to the academic research community and to the government agencies and private organizations that invest in research. Research facilities and equipment are infrastructure investments with regional and national importance for education, economic development, industrial competitiveness, and national security. In many research fields further progress at the leading edge requires new and more productive facilities and equipment. The most obvious and widely known examples are drawn from instrumentation where technical advances of the last two decades have made major observational improvements that represent not only quantitative advances but qualitative improvements as well.

Estimates of the extent of the unmet nationwide need for new construction and renovation vary in the range of $5.0 billion to $20.0 billion in the next 20 years. In testimony before the Committee, witnesses have placed the price tag for bringing laboratory equipment up to a level equal with private industry at $1.0 to $4.0 billion. No matter what the precise estimates, American research efforts are lagging far behind potential opportunities and are certain to suffer in the future if steps are not taken soon to refurbish existing facilities, build new facilities, and purchase more new instructional equipment.

Although the Committee generally applauds the NSF for its continued support for research facilities and equipment, it was disappointed with the level funding request for the College Science Instrumentation Program (CSIP). In response, the Committee increased the authorized funding for the College Science Instrumentation Program by $2.0 million up to $11.5 million. This will authorize more matching funds for the acquisition of modern instrumentation and will move the CSIP closer to the recommendations included in the Neal Report. NSF's initiative to provide support for equipment and instrumentation to meet the needs of experimental research through the provision of multiuser equipment at the university department level will assist in making more effective use of limited resources.

The Committee realizes that Federal agencies other than the NSF have responsibility for support of university research facilities and equipment. However, the Committee believes NSF should assume a lead role in facilities and equipment funding as well as assessing the needs of universities and colleges in this regard. Thus, the Committee expects the NSF to continue data collection and analysis of these needs as required by Public Law 99-159.

BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES

Committee View

The Committee believes that the fields of biological, behavioral and social sciences are ripe for exciting breakthroughs on a variety of fronts. New fields exist not only in the scientific disciplines themselves but in such areas as plant science, neurology, biotechnology, and the evaluation of the impact of technology on society.

The Committee continues its strong support of social and behavioral science research as an integral part of the Foundation's agenda. It is pleased NSF included additional resources for the psychobiology, geographic information, and decision, risk assessment and management science programs as part of the proposed science and technology centers initiative. Concurrently, it is important to continue adequate support for individual investigator initiated research in the social and behavioral sciences. Specifically, the Committee stresses that as new initiatives are launched within the Biological, Behavioral and Social Sciences Directorate and as improvements are made in the design and maintenance of large scale data bases for social and economic sciences, support for individual investigator research will not be diminished.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCOR)

Committee View

EPSCoR was initiated in 1978 in response to concern over the geographic distribution of NSF awards coupled with understanding of the desire of every State to be competitive in at least a few fields of science and engineering. The importance of research universities in attracting high technology industry to a locality is well known. One of EPSCoR's overall objectives is to help insure that every geographic region of the U.S. has access to a first-rate research university. In fiscal year 1988, NSF proposes to continue commitments to eight states and territories, that received initial planning grants in fiscal year 1986, to develop and implement programs for improving basic science and engineering research. Alabama, Kentucky, North Dakota, Nevada, Oklahoma, Puerto Rico, Vermont, and Wyoming received continuing grants. Key criteria for award selection are a state's willingness to invest significant resources toward this effort and a state's ability to make significant enhancements in the quality of current research programs.

The value of EPSCoR is vividly illustrated by the results of an EPSCoR grant to the University of Alabama-Huntsville. The grant was used by a young professor to build a strong research group studying superconductivity. Recently, this group produced one of the first sets of research results on a class of materials that are superconducting (transport electricity without loss from resistance) at relatively high temperatures. This breakthrough has enormously important implications for a wide range of technologies, including high speed computers, medical diagnostic systems, electric power generation, and transportation systems. The Committee strongly supports the goals of EPSCoR and encourages continued support for the program.

NSF'S EARTHQUAKE PROGRAM

Background

The NSF earthquake program is authorized within this bill and H.R. 1612, the Earthquake Hazards Reduction Act authorization for fiscal years 1988 and 1989. The Foundation has both an earthquake engineering and geosciences research program that are part of the National Earthquake Hazards Reduction Program (NEHRP).

The earthquake engineering research program at NSF began in the early 1960's with a budget of less than one million dollars. The program grew steadily and with the passage of the Earthquake Hazards Reduction Act in 1977, the program continued to expand to the current level of $15.1 million. NSF also supports as part of its regular research programs in earth sciences, basic research on the fundamental causes and conditions for earthquake occurrence. For the last five years the NSF, through its continental lithosphere program, has placed special emphasis on earth sciences in its budget request. As the overall budget for earth sciences has grown, the portion devoted to earthquake studies has grown from $7.2 million in fiscal year 1982 to the current level of $10 million. The views of the committee on NSF's participation in the NEHRP follow.

Committee View

Earthquake Hazard Mitigation Program.—The Earthquake Hazard Mitigation (EHM) Program Element within the Critical Engineering Systems Subactivity supports fundamental research in engineering directed toward mitigation of the effects of earthquakes. The internationally recognized research funded by NSF has led to the development of technologies to reduce damage from earthquakes.

One of NSF's most promising projects is the Earthquake Engineering Research Center. The Center was competitively awarded to a consortium headed by the State University of New York at Buffalo, in August 1986. The Center is a cooperative $10 million per year research operation with the cost equally divided between NSF and New York State. The members of the consortium are the City College of New York, Columbia University, Cornell University, Lamont-Doherty Geological Observatory, Lehigh University, Princeton University, Rensselaer Polytechnic Institute, and State University of New York at Buffalo.

The Center will conduct research to improve basic knowledge about earthquakes, engineering practice, and implementation of seismic hazard mitigation procedures in order to minimize the loss of lives and property. Initially research will be directed toward existing structures, particularly "non-engineered" buildings, and to earthquake hazards in the eastern U.S., where earthquakes occur infrequently but can be unusually powerful. The Center will emphasize a systems approach in which earthquake requirements integrated with consideration of other hazards, such as high winds and ground failures. The Committee notes that NSF intends the center to be a national resource, which will not neglect research in other areas of the country, while studying the less-understood consequences of eastern earthquakes.

The Committee applauds NSF's support of research teams to study recent earthquakes, such as the Chile earthquake of March 3, 1985 and the Mexico earthquake of September 19, 1985. The Committee recognizes the importance of capturing the lessons learned from these "living laboratories," which have implications for and application to earthquake engineering in the United States.

The Committee urges NSF and the Earthquake Research Center to devote more attention to research that can mitigate earthquake damage within the next several years. NSF should seek an appropriate balance between research having long-range outcomes and nearer-term results. In administering its research program, advice should be sought from state and local officials and engineers to help focus the program on their most pressing needs.

The Committee has received testimony advocating the need for better utilization of technical and scientific knowledge generated from NSF supported research. NSF should assist in developing mechanisms to broaden the distribution of research findings. The Societal Response component of the program discussed next can be an important element in improving NSF's dissemination efforts.

Societal Response Earthquate Research Component of the Earthquake Hazard Mitigation Program.—Since fiscal year 1986, NSF has discontinued the societal response earthquake program as an identifiable program with a separate budget. The Committee would prefer that an identifiable program be maintained. However, the Committee appreciates the Foundation's rationale that the overhead associated with a separate program cannot be justifed. Thus, the Committee directs NSF to monitor the program to ensure that funds consistent with the importance of the program continue to be obligated.

The need for research on policy analysis, program evaluation, organizational response, technology transfer, and knowledge diffusion are too valuable to be lost as an identifiable part of the Earthquake Hazard Mitigation Program. The Committee strongly urges NSF to continue support of this integral component of the NEHRP.

Basic Earth Sciences.—The Geosciences Directorate of NSF also supports research as part of the NEHRP in its Earth Sciences Program. The program supports research on such topics as earthquake mechanisms, crustal movements and seismology. These studies provide the scientific basis for more applied programs.

Earth science continues to be revolutionized by the plate tectonics theory developed in the 1960s, and NSF has been leading the way in improving our understanding the earth.

Fundamental earth sciences research is vital to the long-term success of the NEHRP because it holds the key to understanding the causes and predictable impacts of earthquakes. NSF must, therefore, be certain to address research in the East as well as the West. The causes of eastern earthquakes are less understood, and their impact could be far more disastrous. The Committee appreciates the attention NSF has been paying to this problem.

The Committee applauds projects such as the Scientific Drilling project at Cajon Pass, in California; the Consortium for Continental Reflection Profiling project to locate and map crustal deep faults that are not visible at the earth's surface; projects to use the satellite-based Global Positioning System to make precise measurements of crustal deformation in areas where active movements are now taking place; and the IRIS (Incorporated Research Institutions for Seismology), a consortium of 50 universities representing 26 states, which is working with the USGS to upgrade the global digital seismographic network. While the Committee is pleased with the NSF program in the Earth Sciences, it recommends the program be reviewed to ensure that the goals, priorities and objectives of the overall NEHRP are met.

THE INTERNATIONAL GEOSPHERE BIOSPHERE PROGRAM

Background

The International Geosphere Biosphere Program (IGBP) is a new initiative in science that will address major environmental problems that are common to all who live on the Earth. The IGBP will take advantage of the power of remote sensing of the Earth from space; the emerging technology of new generations of computers to process and comprehend the awesome amounts of data that will be involved, and the cooperation and collaboration of many scientific disciplines and the national efforts of more than 100 countries of the world. The goal of the program is to describe and understand the interactive physical, chemical and biological processes that regulate the unique environment that the Earth provides for life, the global changes that are now occurring in this system, and the role of human actions in disturbing the national balances of the system. The IGBP will begin in earnest in 1992 and will continue for at least a decade.

The IGBP was an idea that took shape over the last three years in this country through actions in the National Council. During that time, the Committee encouraged the idea of an IGBP. The critical international link was forged last September in Switzerland when the IGBP was unanimously and enthusiastically endorsed, after two years of study, at the 21st General Assembly of the International Council of Scientific Unions (ICSU) in Berne. ICSU is the highest council of science: an international, non-governmental scientific organization whose principal objective is to encourage international scientific activity for the benefit of humankind. The U.S. is represented by the National Academy of Sciences and by U.S. members of the 20 participating international scientific unions. The IGBP has the potential to be the most ambitious, and the most promising, endeavor in man's long history of understanding the planet on which he lives.

The U.S. contribution to IGBP will consist of coordinated efforts in many federal agencies, under the general rubric of "Global Change". The National Science Foundation is the lead agency with its Global Geosciences program. This program involving participation by NASA, NOAA, USGS and DOE ties together related programs in the biological sciences, atmospheric science, oceanography, solid earth studies, and polar programs. The NASA Advisory Council commissioned in 1983 a major study of "Earth System Sciences" that has provided, and will continue to provide, both the intellectual framework and the down-to-earth requirements of the coordinated programs of measurement and monitoring that will be required. NOAA has now under study a new contribution program, called "Global Climate Change", that would make use of the expertise and experience of that agency, focusing on changes in the atmosphere and ocean components of the Earth system. DOE is now contemplating its proper role in the effort, as is the DOD, through research activities of the Office of Naval Research. The coordination of U.S. programs in Global Change with the ICSU IGBP will be made through the National Research Council. In addition, there will soon be a coordinating mechanism to link the principals involved in all the major U.S. scientific agencies who will work on this global program.

Committee View

The Committee welcomes the progress and plans for U.S. participation in the IGBP. These efforts respond to the challenge of a rapidly-changing world with research programs for providing the fundamental knowledge that can serve as a basis for assessing likely, future changes on the Earth during the next 100 years. The Committee request that it be kept fully informed of futher progress and new plans.

To be successful, the Global Geosciences program requires cooperation, coordination and support from the several federal agencies involved. The Committee is concerned that some of the agencies may not be able to meet planned commitments to this program in fiscal year 1988 due to significant shortfalls from previously projected budget levels. The Committee requests that NSF assess the impact on the Global Geosciences program of any significant reductions in support for its many interconnected parts, should reductions occur, and inform the Committee in a timely fashion of how the NSF-supported part of the joint activities will be modified as a result of actions by other agencies.

The Office of Science and Technology Policy (OSTP) provided an initial stimulus to the creation of the Global Geosciences inititative and has been a supporter of the activity. As the overall coodinator and advocate for scientific research within the Executive Branch, OSTP is in a position to assist in ameliorating the problem of budget, shortfalls damaging interagency research programs, which have been fully justified and identified as having high merit. The Committee requests that NSF formally approach OSTP, if justified by the Foundation's assessment of the impact of reduced participation by the agencies contributing to the Global Geosciences program, and request OSTP involvement in protecting the viability of this important interagency research program.

EFFECT OF TAX REFORM

Committee View

The Committee notes that the Tax Reform Act of 1986 (P.L. 99-514) will cause significant changes for students and universities that may require re-examination of NSF policies. The provisions that affect students and universities most directly include those dealing with taxation of fellowships and scholarships, deductibility of student loan interest, credits for business contributions to university research, and limits on issuance of tax-exempt bonds.

The Committee expects that NSF will continue to monitor the impact of the tax law on university research and education, and will propose changes in its policies as they become necessary. NSF has already demonstrated its responsiveness by increasing the stipend for graduate students from $11,100 to $12,300 per year to prevent the tax law from reducing the value of the fellowship.

The Committee expects that the impact of the tax law will be discussed in relevant reports, such as the annual facilities survey required by P.L. 99-159.

ACID PRECIPITATION

Committee View

The Committee is pleased with NSF's continuing interest in research to understand the causes and effects of acid rain. NSF reports that funding for research in acid rain increased in fiscal year 1986 to $1.49 million from $1.19 million in fiscal year 1985.

The Committee directs NSF to continue its support of fundamental research to advance our understanding of this environmental hazard. The Committee further directs NSF to continue monitoring grant awards for acid rain research and to provide the Committee with a report listing the number and dollar amount of the awards by program as soon as such information is available at the end of the fiscal year.

SMALL BUSINESS AND ACCESS TO CENTERS

Committee View

Small businesses are responsible for much for the Nation's economic growth, job creation and inventiveness. Any agency that hopes to improve economic competitiveness must ensure that it involves small firms in its programs.

Congress underscored the importance of incorporating small businesses in federal research programs by extending the Small Business Innovative Research (SBIR) program (P.L. 99-443), which sets aside federal research money for those firms.

NSF has done an excellent job of administering its SBIR program, but small businesses may be able to take advantage of other programs as well.

The Committee directs NSF to encourage the transfer of scientific and technological information developed by its centers (e.g., Engineering Research Centers) to businesses, particular small- and medium-sized ones, that are not members of the centers.

Technology transfer methods may include the appointment of an individual responsible for technology transfer at each center, the dissemination of information to existing State technical assistance programs, or other mechanisms.

By January 1, 1988, NSF shall submit a progress report describing the actions taken to increase technology transfer, their expected impact, and future plans.

SUPERCONDUCTIVITY

Committee View

The Committee applauds the Foundation's response to the emerging opportunities and challenges confronting the Nation in the area of superconducting materials. For example, the Mathematical and Physical Sciences Directorate awarded $1 million for research on high temperature superconducting materials by teams at three Materials Research Laboratories immediately following the February 16, 1987 announcement of breakthroughs in superconductors. In addition, the Engineering Directorate has initiated "quick start" grants for researchers with promising ideas for processing superconducting materials into useful forms, including wires, rods, tubes, films, and ribbons. In all, NSF expects to provide about $6.6 million to support research on superconductivity in fiscal year 1987. The fiscal year 1987 level is almost double the level of effort in fiscal year 1986. The Committee encourages NSF to continue to look for mechanisms to rapidly fund research to exploit and compliment recent scientific breakthroughs, such as those implemented for superconductivity research, and thus enhance the benefits from prior research investments.

The Committee notes that since the announcement of the February 16, 1987 breakthrough in superconductors, other agencies such as DoD, DOE, NASA, and NBS have also shifted federal research money into studies of new superconducting materials. Although the Committee is pleased with this response, the Committee recommends that OSTP coordinate these quick response efforts among the various agencies to assure the effective expenditure of resources and to avoid unnecessary duplication of efforts.

STUDY ON NEW DIRECTIONS FOR U.S.-LATIN AMERICAN COOPERATION IN SCIENCE AND TECHNOLOGY

Committee View

The National Academy of Sciences' Office on International Affairs, through the Board on Science and Technology for International Development (BOSTID), has received an NRC Program Initiative Fund (PIF) grant in 1987, to explore opportunities for Inter-American cooperation. An initial meeting was held on February 3, 1987, with the federal civilian research and development agencies, and selected professional societies to receive input on agency programs and experiences on science, space, and technology inter-American cooperation. In March, at a second NAS meeting, an ad hoc program planning meeting of scientists was to discuss opportunities for cooperation.

Due to the importance of NSF involvement in international science, the current and future potential opportunities for inter-American cooperation, and the stragetic need for intercontinental relations, the Committee directs NSF to work with other appropriate federal R&D agencies, including DOE, and NASA, and other independent bodies to chart new directions for U.S.-Latin American cooperation.

The Committee directs that an independent, interagency study of current activities, an evaluation of the effectiveness of different mechanisms for cooperation, and suggestions of appropriate new action, federal and non-federal, to further enhance science, space, and technology intercontinental collaboration, is an appropriate course of action.

Furthermore, a study combining this information should also address why the U.S. should be concerned with scientific cooperation in the hemisphere and which present U.S.-Latin American activities would help further cooperation.

The study should examine opportunities, identify priority countries and fields of action, and recommend, where appropriate, mechanisms—bilateral, multilateral and private which have been effective in the past (providing reason why they were effective), as well as those which have promise in the future.

Not later than June 30, 1988, the Committee requires a final report. The Committee anticipates that funds for this study will come from private sources and the appropriate Federal Government agencies, and would not exceed a total cost of $250,000.

V. CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

In compliance with clause 3 of Rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, existing law in which no change is proposed is shown in roman):

NATIONAL SCIENCE FOUNDATION ACT OF 1950

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NATIONAL SCIENCE BOARD

SEC. 4. (a)

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(k) Portions of Board meetings in which the Board considers possible Foundation budgets for a particular fiscal year that might be submitted to the Congress may be closed to the public until the President's budget for that fiscal year has been submitted to the Congress.

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SECURITY PROVISIONS

SEC. 15. (a) * * *

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[(c)(1) No part of any funds appropriated or otherwise made available for expenditure by the Foundation under authority of this Act shall be used to make payments under any scholarship or fellowship awarded to any individual under section 10, unless such individual—

[(A) has taken and subscribed to an oath or affirmation in the following form: "I do solemnly swear (or affirm) that I bear true faith and allegiance to the United States of America and will support and defend the Constitution and laws of the

United States against all its enemies, foreign and domestic"; and

[(B) has provided the Foundation (in the case of applications made on or after October 1, 1962) with a full statement regarding any crimes of which he has ever been convicted (other than crimes committed before attaining sixteen years of age and minor traffic violations for which a fine of $25 or less was imposed) and regarding any criminal charges punishable by confinement of thirty days or more which may be pending against him at the time of his application for such scholarship or fellowship.

The provisions of section 1001 of title 18, United States Code, shall be applicable with respect to the oath or affirmation and statement herein required.

[(2)(A) When any Communist organization, as defined in paragraph (5) of section 3 of the Subversive Activities Control Act of 1950, is registered or there is in effect a final order of the Subversive Activities Control Board requiring such organization to register,* it shall be unlawful for any member of such organization with knowledge or notice that such organization is so registered or that such order has become final (i) to make application for any scholarship or fellowship which is to be awarded from funds part or all of which are appropriated or otherwise made available for expenditure under the authority of section 10 of this Act, or (ii) to use or attempt to use any such award.

[(B) Whoever violates subparagraph (A) of this paragraph shall be fined not more than $10,000, or imprisoned not more than five years, or both.]

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VI. OVERSIGHT ACTIVITIES

HEARINGS

Testimony was given by NSF personnel or others on NSF related matters at oversight hearings held by the Committee between July 1986 and May 1987:

National Science Foundation Authorization Hearings

Posture Hearing on the President's Fiscal Year 1988 Budget for Research and Development—January 28, 1987.

Posture Hearing on the National Science Foundation—March 24, 1987.

Authorization Hearings on the Fiscal Year 1988 Budget for the National Science Foundation—February 19 and 25, 1987 and March 11, 1987.

Other Related Hearings

Scientific Research and University Finances (Hearings of the Science Policy Task Force)—September 16 and 18, 1986.

Inspection of NSF Supported Facilities

National Radio Astronomy Observatory—Very Large Array, Socorro, NM—August 25, 1986.

Scripps Institute of Oceanography, San Diego, CA—August 28, 1986.

Center for Robotic Systems in Microelectronics, University of California, Santa Barbara, CA—August 28, 1986.

ATTENDANCE AT NSF MEETINGS

Committee staff members have attended, or have studied reports of, numerous NSF meetings of the following types: National Science Board meetings, program reviews, program planning sessions, scientific conferences, meetings of the Committee on Equal Opportunities in Science and Technology, and advisory committee meetings.

They have also met with NSF personnel on a variety of working topics including: accountability in research and grant management; history, nature, and accomplishment of selected programs; evaluation procedures for grant proposals; amendments to the NSF Organic Act, and Directorate-by-Directorate pre-budget reviews of programs, problems, and plans.

GAO REPORTS

In the past year, the General Accounting Office has issued the following reports dealing with the National Science Foundation:

"University Funding: Federal Funding Mechanisms in Support of University Research"—July 11, 1986.

"Biotechnology: Analysis of Federally Funded Research"—October 25, 1985.

"University Funding: Information on the Role of Peer Review at NSF and NIH"—March 26, 1987.

OTA REPORTS

In the past year, the Office of Technology Assessment has issued the following report relating to the National Science Foundation:

"Research Funding As An Investment: Can We Measure the Returns?" (A Technical Memorandum)—April, 1986.

VII. OVERSIGHT FINDINGS AND RECOMMENDATIONS BY THE COMMITTEE ON GOVERNMENT OPERATIONS

No statement of findings and recommendations on oversight activity pursuant to Rule X, clause 2(b)(2), and Rule XI, clause 2(l)(3)(D), of the Rules of the House of Representatives, have been submitted by the Committee on Government Operations for inclusion in this report.

VIII. Congressional Budget Office Cost Estimate

U.S. Congress,
Congressional Budget Office,
Washington, DC, May 21, 1987.

Hon. Robert A. Roe,
Chairman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

Dear Mr. Chairman: The Congressional Budget Office has prepared the attached cost estimate for H.R. 2330, the National Science Foundation Authorization Act for Fiscal Year 1988.

If you wish further details on this estimate, we will be pleased to provide them.

With best wishes,

Sincerely,

Edward M. Gramlich,
Acting Director.

CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

1. Bill number: H.R. 2330.

2. Bill title: National Science Foundation Authorization Act for Fiscal Year 1988.

3. Bill status: As amended and ordered reported by the House Committee on Science, Space, and Technology, May 20, 1987.

4. Bill purpose: This bill authorizes the appropriation of $1,893 million in fiscal year 1988 for the National Science Foundation (NSF). Of that amount, $1,625 million is for research and related activities, $150 million is for science and engineering education activities, and $118 million is for the U.S. Antarctic program.

5. Estimated cost to the Federal Government:

[By fiscal year, in millions of dollars]

	1988	1989	1990	1991	1992
Authorization level	1,893				
Estimated outlays	876	836	145	36	

Including outlays from previous years' appropriations, total NSF outlays for fiscal year 1988 are estimated to be $1,764 million, assuming the amounts authorized in H.R. 2330 are appropriated.

The costs of this bill fall within budget function 250.

Basis of estimate: This estimate assumes that all amounts authorized are appropriated prior to the beginning of fiscal year 1988 and that outlays follow historical spending patterns.

6. Estimated cost to State and local governments: None.

7. Estimate comparison: None.

8. Previous CBO estimate: None.

9. Estimate prepared by: Paul M. DiNardo. (226-2860)

10. Estimate approved by: C.G. Nuckols (for James L. Blum, Assistant Director for Budget Analysis).

IX. IMPACT ON INFLATION

In accordance with Rule XI, clause 2(l)(4) of the Rules of the House of Representatives, the following statement is made concerning the inflationary impact of H.R. 2330.

H.R. 2330 is assessed to have no inflationary effect on prices and costs in the operation of the national economy.

X. COMMITTEE RECOMMENDATION

A quorum being present, the bill was ordered reported on May 20, 1987, by a voice vote of the Committee.

XI. ADMINISTRATION VIEWS

NATIONAL SCIENCE FOUNDATION,
Washington, DC, February 26, 1987.

Hon. ROBERT A. ROE,
Chairman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: The President has included a draft authorization for the National Science Foundation for fiscal years 1988 through 1992 as Title II of his proposed "Trade, Employment, and Productivity Act of 1987", submitted to Congress on Thursday, February 19, 1987. Enclosed is a copy of that title and its sectional analysis.

This draft title offers the Congress the opportunity to join the Administration in committing to double the Foundation's budget by fiscal year 1992. For the first time, appropriation of specific amounts for more than just the next fiscal year would be authorized, with planned levels established for our three appropriation accounts in fiscal year 1989 and for total spending in the following three fiscal years. Such increases are necessary even in a period of severe fiscal constraints, because America's economic strength depends on people coming together to generate ideas and create products that keep us ahead of our competitors.

Adequate and dependable funding would allow the Foundation to undertake new initiatives aimed at improving long-term economic productivity and competitiveness while sustaining and strengthening our existing university science and technology base. Together with industry we would establish new Basic Science and Technology Centers to perform both scientifically exciting and economically promising research. We would also enhance incentives for top students to choose science and engineering careers. I look forward to working with Congress to keep the American research enterprise strong and vital.

Sincerely,

ERICH BLOCH, *Director.*

Enclosures.

TITLE II—NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT

SHORT TITLE

SEC. 2001. This title may be cited as the "National Science Foundation Authorization Act for Fiscal Years 1988 through 1992."

AUTHORIZATION OF APPROPRIATIONS

SEC. 2002. Congress finds that to strengthen national economic productivity and competitiveness the programs of the National Science Foundation should be doubled in size over the next five years. To that end there is authorized to be appropriated to the National Science Foundation:

(a) For the fiscal year 1988, $1,893,000,000. Such funds will be available for the following categories:

(1) Biological, Behavioral, and Social Sciences, $297,000,000.

(2) Computer and Information Science and Engineering, $143,000,000.

(3) Engineering, $205,000,000.

(4) Geosciences, $330,000,000.

(5) Mathematical and Physical Sciences, $514,000,000.

(6) Scientific, Technological, and International Affairs, $51,000,000.

(7) Program Development and Management, $95,000,000.

(8) Science and Engineering Education, $115,000,000.

(9) United States Antarctic Program, $143,000,000.

(b) For the fiscal year 1989, $2,158,000,000, including $1,877,000,000 for research and related activities, $134,000,000 for science and engineering education, and $147,000,000 for the United States Antarctic Program.

(c) For the fiscal year 1990, $2,474,000,000.

(d) For the fiscal year 1991, $2,831,000,000.

(e) For the fiscal year 1992, $3,245,000,000.

AVAILABILITY OF APPROPRIATIONS

SEC. 2003. Appropriations made under authority provided in section 2002 shall remain available for obligation for periods specified in the Acts making the appropriations.

CONSULTATION AND REPRESENTATION EXPENSES

SEC. 2004. From appropriations made under authorizations provided in this Act, not more than $7,500 may be used in each fiscal year for official consultation, representation, or other extraordinary expenses at the descretion of the Director of the Foundation. The determination of the Director will be final and conclusive upon the accounting officers of the Government.

TRANSFER OF FUNDS

SEC. 2005. (a) Funds may be transferred among the categories listed in section 2002, so long as the net funds transferred to or from any category do not exceed 10 percent of the amount authorized for that category in section 2002.

(b) In addition, the Director of the Foundation may propose transfers to or from any category exceeding 10 percent of the amount authorized for that category in section 2002. An explanation of any such proposed transfer must be transmitted in writing to the Committee on Science and Technology of the House, and the Committees on Labor and Human Resources and Commerce, Science, and Transportation of the Senate. The proposed transfer may be made only when 30 calendar days have passed after transmission of such written explanation.

NSF ADMINISTRATIVE AMENDMENTS

SEC. 2006. (a) Section 4 of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1863) is amended by adding to its end a new subsection (k) as follows:

"(k) Portions of Board meetings in which the Board considers possible Foundation budgets for a particular fiscal year or other legislative proposals that might be submitted to Congress may be closed to the public until the President's budget for that fiscal year or the legislative proposal has been submitted to the Congress."

(b) Section 5(b) of the National Science Foundation Act of 1950 (42 U.S.C. 1864(b)) is amended to read:

"(b) Except as otherwise specifically provided in this Act (1) the Director is the head of the agency and shall exercise all the authority granted to the Foundation by this or any other Act (including any powers and functions which may be delegated to him by the Board), and (2) all actions taken by the Director pursuant to the provisions of this or any other Act (pursuant to the terms of a delegation from the Board) shall be final and binding upon the Foundation."

(c) Section 7 of the National Science Foundation Act of 1950 (42 U.S.C. 1865) is amended to read:

"The Executive Committee of the Board shall be composed of the Director ex officio, who shall chair the Committee, and at least four other Board members elected by the Board. The Executive Committee shall exercise such powers and functions as may be delegated to it by the Board."

(d) Section 14(d) of the National Science Foundation Act of 1950 (42 U.S.C. 1873(d)) is amended by inserting the words "Board and persons holding other offices in the Federal Government may serve as members of" before "special".

(e) Subsection 15(c) of the National Science Foundation Act of 1950 (42 U.S.C. 1874(c)) is repealed.

(f) Part B of the National Science Foundation Authorization and Science and Engineering Equal Opportunity Act (42 U.S.C. 1885 to 1885d, 94 Stat. 3010), as amended and redesignated by section 111 of the National Science Foundation Authorization Act for Fiscal Year 1986 (P.L. 99-159, 99 Stat. 892), is amended as follows.

(1) Section 36(b) (42 U.S.C. 1885c(b)) is amended to read:

"(b) Each member of the Committee shall be appointed by the Director of the National Science Foundation. Members shall be appointed to serve for a three-year term, and may be reappointed for an additional term of three years."

(2) Sections 36(f) (42 U.S.C. 1885c(f)) is amended to read as follows:

"(f) Every two years, the Committee shall prepare and transmit to the Director a report on its activities during the previous two years and proposed activities for the next two years. The Director shall transmit to Congress the report, unaltered, along with comments."

TITLE II—NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT—SECTION-BY-SECTION ANALYSIS

Section 2001. Permits the citation of the Act as the "National Science Foundation Authorization for Fiscal Years 1988, 1989, 1990, 1991, and 1992."

Section 2002. Authorizes appropriations of $1,893,000,000 in nine categories for FY 1988; $2,158,000,000 in three areas for FY 1989; $2,474,000,000 for FY 1990; $2,831,000,000 for FY 1991; and $3,245,000,000 for FY 1992.

Section 2003. Provides that appropriations made under section 2002 will remain available for periods specified in appropriations acts.

Section 2004. Authorizes annual expenditures of up to $7,500 for FY 1988 through FY 1992 for official consultation, representation, and other extraordinary expenses at the discretion of the Director.

Section 2005. Provides that funds may be transferred among categories but precludes transfers to or from any category exceeding 10 percent of the amount listed for that category until thirty calendar days have passed after the Director has notified the Speaker, the Vice President, and the Senate and House authorization committees of the nature of the transfer and the reason for it.

Section 2006. Contains five amendments to the National Science Foundation Act and one to a related law. The proposed changes together with changes made in other years serve a long-term purpose. They represent a continued collaboration between the Foundation and the congressional committees charged with oversight of its activities to simplify and streamline its organic legislation.

PROPOSED AMENDMENT NO. 1

Section 2006(a) provides "Section 4 of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1863), is amended by adding to its end a new subsection (k) as follows:

" '(k) Portions of Board meetings in which the Board considers possible Foundation budgets for a particular fiscal year or other legislative proposals that might be submitted to Congress may be closed to the public until the President's budget for that fiscal year or the legislative proposal has been submitted to the Congress.' "

This addition to section 4 of the National Science Foundation Act of 1950 would exempt discussions by the National Science Board of proposed NSF budgets and other legislative initiatives from disclosure under the Government in the Sunshine Act (5 U.S.C. 552b) until the President submits his or her budget and legislative program for that fiscal year.

This amendment is necessary to restore the quality of the National Science Board's participation in the Executive budget-planning process. Because the United States Court of Appeals for the District of Columbia has held that budget discussions by collegially-headed agencies are not exempt from the Government in the Sunshine Act, *Common Cause* v. *Nuclear Regulatory Agency,* 674 F.2d 921 (1982), recent Board budget-planning discussions have been open to the public. Before the court decision, budget discussions took place in closed sessions.

The Executive budget process requires negotiations and discussions between the Foundation and the Office of Management and Budget. The Foundation's budget documents are components of the Administration's overall budget and are, like similar documents of all other agencies, required by Office of Management and Budget Circular No. A-10 to be kept confidential until released by the President. Copies cannot be made available to public observers when the Board attempts to discuss and vote on them. The presence of public observers in open sessions of the Board inhibits members of the Board from discussing budget specifics, because that would disclose the President's tentative budget. As a result, effective National Science Board input to NSF budget positions has been fragmented and now occurs only at lower levels and in informal discussions between individual members and NSF staff. Such discussion as does take place in open sessions has tended to be pro forma. This diminishes the ability of the Board to guide NSF programs while adding nothing to openness in Government, particularly considering that the resulting budget gets a complete airing as part of the Congressional process. The Foundation is different in this respect from the other four dozen agencies affected by the Sunshine Act.

The proposed amendment creates a statutory exemption for NSB budget discussions. The exemption would be limited, both substantially and temporarily. It would allow the National Science Board to close only those portions of meetings in which not yet publicly-proposed NSF budgets are being considered. Discussions by the Board of possible Foundation actions under any Presidential budget that has been submitted to Congress or under any alternative proposed by Congress, as well as Board discussions of actions under enacted appropriations, would not be affected.

The amendment also exempts from disclosure Board discussion of legislative initiatives, such as this one, which are usually ssubmitted to Congress in the Foundation's draft annual authorization bill. Like the NSF budget, these initiatives are part of the President's legislative program and must be cleared by the Office of Management and Budget. Also like the budget, they will be fully aired by the Congress.

No increase in cost or personnel will result if this proposal is enacted.

PROPOSED AMENDMENT NO. 2

Section 2006(b) provides "Section 5(b) of the National Science Foundation Act of 1950 (42 U.S.C. 1864(b)) is amended to read:

" '(b) Except as otherwise specifically provided in this Act (1) the Director is the head of the agency and shall exercise all the authority granted to the Foundation by this or any other Act (including any powers and functions which may be delegated to him by the Board), and (2) all actions taken by the Director pursuant to the provisions of this or any other Act (or pursuant to the terms of a delegation from the Board) shall be final and binding upon the Foundation.' "

This amendment would add the italicized words to Section 5(b) of the National Science Foundation Act of 1950:

(b) Except as otherwise specifically provided in this Act (1) the Director *is the head of the agency and* shall exercise all the authority granted to the Foundation by this *or any other* Act (including any powers and functions which may be delegated to him by the Board), and (2) all actions taken by the Director pursuant to the provisions of this *or any other* Act (or pursuant to the terms of a delegation from the Board) shall be final and binding upon the Foundation.

Many laws provide that the "head of the agency" has certain administrative responsibilities or powers. The proposed addition to section 5(b) of the National Science Foundation Act of 1950 merely clarifies that the Director is normally for such purposes the "head of the agency" for the Foundation. This is consistent with longstanding NSF interpretation and practice.

This clarification is sought because language in amendments to the Inspector General Act proposed last year raised a question as to whether the NSF audit officer would be required to report to the Director or to the Chairman of the National Science Board.

This amendment would neither alter the relationship between the Director and the National Science Board under the NSF Act nor prevent Congress or the President from giving responsibilities or powers to the Board.

No increase in cost or personnel will result if this proposal is enacted.

PROPOSED AMENDMENT NO. 3

Section 2006(c) provides "Section 7 of the National Science Foundation Act of 1950 (42 U.S.C. 1865) is amended to read:

" 'The Executive Committee of the Board shall be composed of the Director ex officio, who shall chair the Committee, and at least four other Board members elected by the Board. The Executive Committee shall exercise such powers and functions as may be delegated to it by the Board.' "

Section 7 of the National Science Foundation Act (42 U.S.C. 1865) now provides:

(a) There shall be an Executive Committee of the Board (referred to in this Act as the "Executive Committee"), which shall be composed of five members and shall exercise such powers and functions as may be delegated to it by the Board. Four of the members shall be elected as provided in subsection (b), and the Director ex officio shall be the fifth member and the chairman of the Executive Committee.

(b) At each of its annual meetings, the Board shall elect two of its members as members of the Executive Committee, and the Executive Committee members so elected shall hold office for two years from the date of their election. Any person, other than the Director, who has been a member of the Executive Committee for six consecutive years shall thereafter be ineligible for service as a member thereof during the two-year period following the expiration of such sixth year. For the purposes of this subsection, the period between any two consecutive annual meetings of the Board shall be deemed to be one year.

(c) Any person elected as a member of the Executive Committee to fill a vacancy occurring prior to the expiration of the term for which his predecessor was elected shall be elected for the remainder of such term.

(d) The Executive Committee shall render an annual report to the Board, and such other reports as it may deem necessary, summarizing its activities and making such recommendations as it may deem appropriate. Minority views and recommendations, if any, of members of the Executive Committee shall be included in such report.

This provision has changed considerably since it was enacted as part of the original NSF Act (64 Stat. 149, P.L. 81-507). At first, the National Science Board was authorized, but not required, to have a ten-member Executive Committee, with the Director as a nonvoting ex officio member. The Board could not delegate policy-making and award review or approval functions to it (64 Stat. 151, sections 6(a) and 6(b) of P.L. 81-507). In 1959, the ban on delegation of award review or approval functions was eliminated and the membership was allowed to fluctuate between six and ten (73 Stat. 467, section 4 of P.L. 86-232). Reorganization Plan No. 2 of 1962, Part II, established a five-person Executive Committee, with the Director as chairman (76 Stat. 1253, 5 U.S.C. Appendix). This reorganization and other minor changes were enacted in 1968 as part of the "Daddario Amendments" (82 Stat. 364, section 5 of P.L. 90-407).

The proposed amendment would simplify and shorten the language of the section and remove some unnecessary restrictions. It would not substantively alter the membership or function of the Executive Committee. Specifically, it would:

1. Delete the phrase that "[t]here shall be an Executive Committee" from the beginning of subsection (a) because section 4(b) of the Act (42 U.S.C. 1863(b)) already establishes the Executive Committee;
2. Eliminate the ban on any person, other than the Director, serving on the Executive Committee for more than six years;
3. Eliminate the statutory requirement for an annual report from the Executive Committee to the Board; and most importantly
4. Allow the National Science Board to determine the size of and election procedures for its Executive Committee.

Only the last of these changes is likely to make any difference in the composition or operation of Executive Committee.

The first change merely eliminates superfluous language.

Given the infrequency of reappointments to the Board, the ban on more than six years consecutive service on the Executive Committee has largely proved meaningless. If a member of the Executive Committee should be reappointed, however, there seems no justification to foreclose him or her from serving on the Executive Committee so long as a majority of the Board desires. The six-year restriction could, for example, make the Chairman or Vice-Chairman of the Board ineligible to serve on the Executive Committee.

The statutory requirement for an annual report has also proved meaningless, because the Director and other members of the Executive Committee inform other Board members of their activities at every meeting and recently through electronic mail communications between meetings. In any event, the Board can itself establish an annual or other reporting requirement if it feels that the Executive Committee is not keeping it informed.

Elimination of the five-member limit will allow the National Science Board to adjust the size of its Executive Committee in response to organizational needs and member interests. In recent years the Executive Committee has informally included other Board members, particularly NSB committee chairmen, in its meetings and deliberations. Under the revised section 7, the Board could formally add those additional members to the Executive Committee.

Although there is no plan to do so, the Board might adjust the date of Executive Committee elections. In recent even-numbered years, the new "class" of Board members have seldom been appointed by the May annual meeting. The Board might shift the election to an autumn meeting to allow more time for new members to arrive and get acquainted.

Finally, freed from a statutory two-year term, the Board could shorten or lengthen Executive Committee member terms, to encourage either greater involvement by more members or greater stability in Executive Committee membership. At present, however, no change in normal terms of service is planned.

No increase in cost or personnel will result if this proposal is enacted.

PROPOSED AMENDMENT NO. 4

Section 2006(d) provides "Section 14(d) of the National Science Foundation Act of 1950 (42 U.S.C. 1873(d)) is amended by inserting the words 'Board and persons holding other offices in the Federal Government may serve as members of' before 'special'."

This amendment would amend section 14(d) of the National Science Foundation Act to clarify that Executive Branch employees are not ineligible for appointment to the National Science Board and that Legislative and Judicial Branch employees may serve on NSF special commissions.

The amended subsection (d) would read as follows (addition italicized):

(d) Persons holding other offices in the executive branch of the Federal Government may serve as members of the *Board and persons holding other offices in the Federal Government may serve as members of* special commissions, but they shall not receive remuneration for their services as such members during any period for which they receive compensation for their services in such other offices.

Section 14(d) was enacted in 1950. Although it could be read to imply that employees of the legislative and judicial branches are barred from participation on the Foundation's special commissions and all Federal employees from appointment to the National Science Board, the legislative history of the Act indicates otherwise. In a 1946 House of Representatives hearing, an Assistant Surgeon General read from a report of two Public Health Service advisory committees that concluded by recommending:

> That there should be governmental representation on such boards and advisory committees as may be set up in connection with the proposed National Research Foundation.

[Hearings of a Subcommittee of the Committee on Interstate and Foreign Commerce on H.R. 6448, held May 28 and 29, 1946, p. 39.]

The amendment would clarify the language of section 14(d) and make clear that officers and employees of the Executive Branch may serve on the National Science Board and that legislative and judicial employees may serve on NSF special commissions.

There seems no reason why employees of other branches of Government should be generally excluded from service on special commissions. A commission on scientific communication, for example, could benefit from participation by a Copyright Office employee.

Similarly, there seems no reason to exclude all Federal employees from service on the Board or conversely to bar NSB members from accepting other Executive positions. Such a ban was not implied in the one instance known where a Board member was appointed to another Federal position. Clifford M. Hardin was a National Science Board member when he became Secretary of Agriculture in 1969 and remained on the Board for over a year with the President's consent. There is, however, no indication that the wording of section 14(d) was considered by either Secretary Hardin or President Nixon.

Employees of the Legislative and Judicial Branches must, of course, be barred from service on an Executive Branch policymaking body to preserve the constitutional separation of powers.

The National Science Board is intended to represent "the views of scientific and engineering leaders in all areas of the Nation" [NSF Act, section 4(c); 42 U.S.C. 1863(c)]. Government scientists and engineers are an important part of America's scientific and engineering establishment and should not be disenfranchised by statutorily excluding them from membership on the National Science Board.

Similarly, Board members should not be precluded from serving their country in other Federal jobs while on the Board.

Appointment of any Federal employee to the Board or a special commission or of a Board member to another Federal position would, of course, be subject to all conflict-of-interests laws and regulations, including any special restrictions on outside activities peculiar to the employing agency.

No increase in cost or personnel will result if this proposal is enacted.

PROPOSED AMENDMENT NO. 5

Section 2006 provides "Subsection 15(c) of the National Science Foundation Act of 1950 (42 U.S.C. 1874(c)) is repealed."

Subsection 15(c) was enacted as subsection 15(d) of the original NSF Act. It was considerably revised in 1962 (76 Stat. 1069, section 1 of P.L. 87-835) and now provides:

> (1) No part of any funds appropriated or otherwise made available for expenditure by the Foundation under authority of this Act shall be used to make payments under any scholar-

ship or fellowship awarded to any individual under section 10, unless such individual—

(A) has taken and subscribed to an oath or affirmation in the following form: "I do solemnly swear (or affirm) that I bear true faith and allegiance to the United States of America and will support and defend the Constitution and laws of the United States against all its enemies, foreign and domestic"; and

(B) has provided the Foundation (in the case of applications made on or after October 1, 1962) with a full statement regarding any crimes of which he has ever been convicted (other than crimes committed before attaining sixteen years of age and minor traffic violations for which a fine of $25 or less was imposed) and regarding any criminal charges punishable by confinement of thirty days or which may be pending against him at the time of his application for such scholarship or fellowship.

The provisions of section 1001 of title 18, United States Code, shall be applicable with respect to the oath or affirmation and statement herein required.

(2)(A) When any Communist organization, as defined in paragraph (5) of section 3 of the Subversive Activities Control Act of 1950, is registered or there is a final order of the Subversive Activities Control Board requiring such organization to register, it shall be unlawlful for any member of such organization with knowledge or notice that such organization is so registered or that such order has become final (i) to make application for any scholarship or fellowship which is to be awarded from funds part or all of which are appropriated or otherwise made available for expenditure under the authority of section 10 of this Act, or (ii) to use or attempt to use any such award.

(B) Whoever violates subparagraph (A) of this paragraph shall be fined not more than $10,000, or imprisoned not more than five years, or both.

Subsection 15(c)(2) has no continuing effect. The registration requirement was repealed in 1968 (81 Stat. 765, P.L. 90-237). Funding for the Subversive Activities Control Board terminated at the end of Fiscal Year 1973.

So far as is known, the remaining requirements are unique to NSF fellowships and traineeships and have no counterparts in student aid programs of other Federal agencies. Similar requirements once applied to student loans made under the National Defense Education Act, but that program is defunct and the applicable section (20 U.S.C. 581) was omitted from the 1982 edition of the United States Code.

These requirements have existed for over thirty years, but no information received as a result of them has changed an award decision.

Elimination of these two requirements would save NSF fellows and trainees an estimated $100,000 annually and reduce the Foundation's processing costs by an estimated $30,000. About 12,000 paperwork burden hours would be saved each year.

PROPOSED AMENDMENT NO. 6

Section 2006(f) provides "Part B of the National Science Foundation Authorization and Science and Engineering Equal Opportunities Act (42 U.S.C. 1885 to 1885d, 94 Stat. 3010), as amended and redesignated by section 111 of the National Science Foundation Authorization Act for Fiscal Year 1986 (P.L. 99–159, 99 Stat. 892), is amended as follows:

"(1) Section 36(b) (42 U.S.C. 1185c(b)) is amended to read:

" '(b) Each member of the Committee shall be appointed by the Director of the National Science Foundation. Members shall be appointed to serve for a three-year term, and may be reappointed for an additional term of three years.'

"(2) Section 36(f) (42 U.S.C. 1885c(f)) is amended to read as follows:

" '(f) Every two years, the Committee shall prepare and transmit to the Director a report on its activities during the previous two years and proposed activities for the next two years. The Director shall transmit to Congress the report, unaltered, along with comments.' "

These proposed changes to the Science and Engineering Equal Opportunities Act will modify some requirements that have proven burdensome to implement.

Sections 1885 and 1885d of title 42 of the United States Code were enacted in December 1980 as Part B of the National Science Foundation Authorization and Science and Technology Equal Opportunities Act (94 Stat. 3010, P.L. 96–516). In November 1985, section 111 of the National Science Foundation Authorization Act for Fiscal Year 1986 (P.L. 99–159, 99 Stat. 892) amended the 1980 Act by changing "technology" to "engineering" and redesignating it the National Science Foundation Authorization and Science and Engineering Equal Opportunities Act.

In subsection 36(b), "of the National Science Foundation" is added after "Director", to provide a full first reference within this Act. A requirement that the National Science Board concur in all appointments to the Committee on Equal Opportunities in Science and Engineering is eliminated. That proved to add only undue delay to the appointment process. Finally, because the NSB no longer has a separate Committee on Minorities and Women, the provision making its Chairperson an ex officio member of CEOSE is deleted.

The report requirement in subsection 36(f) is changed from annual to biennial, to lessen the administrative demands on the Committee on Equal Opportunities in Science and Engineering.

No increase in cost or personnel will occur if these changes are enacted. Some slight cost saving may be realized from halving the frequency of the CEOSE report.

XII. BUDGET AS REQUESTED

National Science Foundation

Washington, D.C. 20550

FY 1988

Budget Summary

New Obligational Authority:	
FY 1988 Budget Request	**$1,893,000,000**
FY 1987 Appropriations (P.L. 99-500,591)	**$1,622,850,000**
Increase in New Obligational Authority	**$270,150,000**
Program Level:	
FY 1988 Budget Request	**$1,893,000,000**
FY 1987:	
Appropriations (P.L. 99-500,591) **Plus 1986 Carryover**	**$1,622,850,000** **$1,613,742**
FY 1987 Program Level	**$1,624,463,742**
Increase in Program Level FY1988/1987	**$268,536,258**

NATIONAL SCIENCE FOUNDATION

FY 1988 BUDGET TO THE CONGRESS

BUDGET SUMMARY

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SUMMARY OF FY 1988 BUDGET BY APPROPRIATION AND ACTIVITY

	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
RESEARCH AND RELATED ACTIVITIES					
Mathematical and Physical Sciences	$435,310,083	$489,870,000	$463,377,000	$514,000,000	$50,623,000
Engineering	144,906,933	172,470,000	162,765,000	205,000,000	42,235,000
Biological, Behavioral and Social Sciences	239,292,092	270,500,000	257,714,245	297,000,000	39,285,755
Geosciences	266,865,492	298,150,000	284,588,000	330,000,000	45,412,000
Computer and Information Science and Engineering	100,879,284	122,980,000	116,396,000	143,000,000	26,604,000
Scientific, Technological and International Affairs	38,223,465	47,030,000	43,682,000	51,000,000	7,318,000
Program Development and Management	71,836,106	78,000,000	79,100,000	95,000,000	15,900,000
Subtotal, Obligations	***1,297,313,455***	***1,479,000,000***	***1,407,622,245***	***1,635,000,000***	***227,377,755***
Unobligated Balance Available Start of Year	(196,968)	-0-	(1,472,245)	-0-	1,472,245
Unobligated Balance Available End of Year	1,472,245	-0-	-0-	-0-	-0-
Adjustments to Prior Year Accounts	(4,639,425)	-0-	-0-	-0-	-0-
Unobligated Balance Lapsing	110,693	-0-	-0-	-0-	-0-
Research and Related Activities Appropriation	***1,294,060,000***	***1,479,000,000***	***1,406,150,000***	***1,635,000,000***	***228,850,000***
U.S. ANTARCTIC RESEARCH PROGRAM					
U.S. Antarctic Research Program	11,016,352	12,000,000	12,500,000	13,500,000	1,000,000
Operations Support Program	99,144,459	105,000,000	104,580,617	129,500,000	24,919,383
Subtotal, Obligations	***110,160,811***	***117,000,000***	***117,080,617***	***143,000,000***	***25,919,383***
Unobligated Balance Available Start of Year	(59,168)	-0-	(80,617)	-0-	80,617
Unobligated Balance Available End of Year	80,617	-0-	-0-	-0-	-0-
Adjustments to Prior Year Accounts	(31,260)	-0-	-0-	-0-	-0-
U.S. Antarctic Program Appropriation	***110,151,000***	***117,000,000***	***117,000,000***	***143,000,000***	***26,000,000***
SCIENCE AND ENGINEERING EDUCATION ACTIVITIES APPROPRIATION					
Teacher Preparation and Enhancement	26,256,302	27,000,000	30,500,000	36,000,000	5,500,000
Materials Development, Research and Informal Science Education	24,356,300	25,000,000	29,525,000	0	(29,525,000)
Materials Development and Informal Science Education	0	0	0	26,000,000	26,000,000
College Science Instrumentation	5,259,080	7,500,000	9,500,000	9,500,000	0
Research Career Development	25,937,980	27,300,000	27,300,000	36,000,000	8,700,000
Studies and Program Assessment	2,785,179	2,200,000	2,210,693	0	(2,210,693)
Research, Studies and Program Assessment	0	0	0	7,500,000	7,500,000
Subtotal, Obligations	***84,594,841***	***89,000,000***	***99,035,693***	***115,000,000***	***15,964,307***
Unobligated Balance Available Start of Year	(31,494,325)	-0-	(35,693)	-0-	35,693
Unobligated Balance Available End of Year	35,693	-0-	-0-	-0-	-0-
Adjustments to Prior Year Accounts	(20,583)	-0-	-0-	-0-	-0-
Unobligated Balance Lapsing	45,374	-0-	-0-	-0-	-0-
Science and Engineering Education Activities Appropriation	***53,161,000***	***89,000,000***	***99,000,000***	***115,000,000***	***16,000,000***
SPECIAL FOREIGN CURRENCY					
Special Foreign Currency Program	1,098,263	700,000	725,187	0	(725,187)
Unobligated Balance Available Start of Year	(2,417)	-0-	(25,187)	-0-	25,187
Unobligated Balance Available End of Year	25,187	-0-	-0-	-0-	-0-
Adjustments to Prior Year Accounts	(232,030)	-0-	-0-	-0-	-0-
Unobligated Balance Lapsing	67,997	-0-	-0-	-0-	-0-
Special Foreign Currency Appropriation	***957,000***	***700,000***	***700,000***	***0***	***25,187***
TOTAL, NSF APPROPRIATION	***$1,458,329,000***	***$1,685,700,000***	***$1,622,850,000***	***$1,893,000,000***	***700,00***

NATIONAL SCIENCE FOUNDATION FY 1988 BUDGET REQUEST OVERVIEW

The National Science Foundation (NSF) Budget Request for FY 1988 is $1.9 billion, an increase of $269 million or 16.5 percent over the FY 1987 Current Plan. The total includes the following appropriations:

(Millions of Dollars)

	FY 1987 Current Plan	FY 1988 Request	Change 87/88	Percent Increase
Research and Related Activities.............	$1407.6	$1635.0	$ 227.4	16.2%
U. S. Antarctic Program..	117.1	143.0	25.9	22.1%
Science and Engineering Education...............	99.0	115.0	16.0	16.2%
Special Foreign Currency Program.................	0.7	0.0	- 0.7	-100.0%
Total	$1624.4	$1893.0	$ 268.6	16.5%

Beyond the FY 1988 Budget Request displayed above, the Administration proposes a doubling of the budget for the NSF by 1992, with an increase of about 14 percent projected for FY 1989. This commitment is part of a National effort to restore American competitiveness internationally and maintain the standard of living at home.

The President's budget for the National Science Foundation reflects a long-term commitment to significant growth in research and education activities in science and engineering, especially at the Nation's colleges and universities.

Since World War II, new technology has been responsible for nearly half of all productivity increases--more than those due to any other single factor. While productivity in the U.S. remains higher in absolute terms than anywhere else, in relative terms it has declined. From 1973 to 1983, U.S. productivity rose at an annual rate of only about 0.3 percent, while Britain's annual gain was almost five times that, and French and German productivity rose seven times as fast. Japan's rate was nine times ours, and Korea's was fifteen times higher than the U.S. rate.

Only about seven out of every thousand American students receive degrees in engineering, while in Japan the figure is 40. At the graduate level, over 50 percent of all engineering Ph.D.'s awarded by our universities since 1980 have gone to non-U.S. students. Foreign students have been awarded 30 to 40 percent of the doctorates in mathematics and physics in recent years, while the number of degrees awarded to U.S. citizens is declining. The number of entering freshmen indicating an intention to major in the basic sciences fell 38 percent in the nine years ending in 1984. To educate and train the nation's next generation of scientists and engineers will require significant investments now to reverse the downward trend in the production of science and engineering graduates.

Success in the effort to improve the nation's productivity and overall competitiveness will, at least in part, be dependent on a sound and vibrant science and technology enterprise. The continued development of the nation's technology base, and hence an improvement in the nation's ability to compete in the international arena, is dependent, in part, upon the nation's academic basic research system.

A strong, vital science and engineering research base -- people, institutions and facilities -- generates the knowledge and ideas that fuel American ingenuity and entrepreneurial spirit.

The education of future scientists and engineers, and the development of new knowledge and its transfer to industry, are critical to new technologies, products, and an improved competitive posture. The Nation's colleges and universities have the dominant role in this process. The link between research and education is a unique feature of U.S. academic institutions and is their primary strength.

Serious erosion of the research and education base is described in the recent White House Science Council's report on the health of U.S. colleges and universities, A Renewed Partnership (February, 1986). The report describes an alarming decline in the ability of colleges and universities to fulfill their role in forefront science and engineering research and education: nearly a decade of low or no growth in R&D funding beginning in the late 1960's contributed to slowed growth in personnel engaged in university R&D, inadequacy of instrumentation, decay of facilities, and the loss of many students to other fields. The report calls for a major investment in the

Nation's centers of learning to overcome these deficiencies and to sustain recent trends of improved support.

The Administration proposes significant growth for federal basic research funding in FY 1988 and for the next several years. The increase for the National Science Foundation in FY 1988 is the first step in a broader plan to double the NSF budget for university-based basic research by 1992. This builds on the strong support the Administration has provided to NSF and the university community since 1982. It is a serious commitment to solving a serious problem.

The Foundation's budget request encompasses three major thrusts which provide a framework for a national commitment to strengthen research and education in science and engineering at colleges and universities by:

- developing human resources and broadening participation in science and engineering;
- establishing science and technology centers and groups to enhance economic competitiveness; and
- strengthening basic disciplinary research programs and improving the facilities that support them.

DEVELOPING HUMAN RESOURCES AND BROADENING PARTICIPATION

The future of U.S. science, engineering and technology depends on human resources. The availability of highly trained scientists and engineers is key to a healthy, competitive economy. Numerous reports -- from the White House Science Council, the National Science Board and the American Council on Education -- have identified serious problems with the quality and size of the talent pool.

The Foundation's FY 1988 Budget includes a total investment of $273 million in education and human resources. These funds will be used both to increase ongoing efforts and to initiate a set of activities directed at strategic points in the educational sequence and in professional development. Efforts to assure broadly based participation, including geographic diversity, are expanded. Data base activities and analytical studies are augmented to permit better evaluation of current practices and to generate improved information on career patterns.

Current precollege efforts for improved teaching, materials and informal science education will be complemented by new enrichment activities for talented high school students. Special opportunities will be provided for hands-on research experience in order to encourage interest and increase first hand information about science and engineering careers. Emphasis on the application of advanced technologies to science and engineering education will continue. About $68 million will be invested in precollege activities in FY 1988.

Undergraduate education has recently been the focus of intense examination. The National Science Board report Undergraduate Science, Mathematics and Engineering Education (March, 1986) identifies pressing needs for improvement in the quality of undergraduate instruction. In FY 1988 the Foundation will more than double its support for activities in this critical educational segment, to nearly $70 million. New and expanded activities will include four major components, to be supported NSF-wide:

- instrumentation and laboratory instruction;
- student research participation;
- faculty enhancement; and
- curriculum development in calculus and engineering.

Graduate and postdoctoral education provide the principal professional training for scientists and research engineers. The Foundation now supports graduate assistants and postdoctoral researchers through research project support and competitive fellowships. A total of about 1700 fellows, 14,000 graduate assistants and nearly 3700 postdoctoral associates will be supported in FY 1988. Special emphasis will be placed on increasing support for interdisciplinary training opportunities in such areas as biotechnology, mathematics and political economy.

Continued growth in the Presidential Young Investigators program will encourage promising young scientists and engineers to enter and remain in academic careers. Two hundred new five year awards will be made in FY 1988, bringing the total number of such awards to about 900. Total NSF funding is expected to be over $50 million.

Future excellence in science and engineering requires that the U.S. draw fully on the untapped and growing talent pool of groups that are presently underrepresented in Nation's science and technology activities. In FY 1988, support through special, focused efforts will total $28 million. Current focused programs for female, minority and disabled investigators will be increased. New activities will focus on development of model programs designed to attract and retain members of underrepresented groups in science and engineering studies and careers. Minority resource centers will be established to support activities at all levels of education to increase participation of minorities in science and engineering.

Broader more diverse participation in research is also promoted through the Experimental Program to Stimulate Competitive Research (EPSCoR). In FY 1988, $6 million is provided for second year awards to eight states for projects to increase their competitive standing in science and engineering.

SCIENCE AND TECHNOLOGY CENTERS AND RESEARCH GROUPS

The multidisciplinary center approach for advancing research at the cutting edge of knowledge has been well established through the Foundation's Engineering Research Centers program, and will be extended through the establishment of Biotechnology Centers addressed in a recent NSF program solicitation. Another approach to centers has been successfully demonstrated in the Advanced Scientific Computing Centers. The White House Science Council report recommends establishing science and technology centers in all disciplines, because of the key role such university-based centers can have in stimulating economic competitiveness.

Centers can accelerate scientific progress in many ways and, in some situations, are the only way to bring multidisciplinary talents to bear on emerging, complex research topics. Strong industry participation not only leverages federal research dollars, but also enhances the transfer of knowledge from research laboratories to the market place. Centers also offer unique education and training opportunities for both academia and industry.

Research groups are also an effective and sometimes essential means of conducting research. Investigators work together on interdisciplinary topics at the departmental, interdepartmental, regional or even international level. Coordinated research, shared data, and common instrumentation and equipment are directed at major challenges in the life and physical sciences. Many of these areas are of great potential benefit both to broad national needs and to economic productivity.

The Foundation's FY 1988 budget includes a total of $529 million for centers and research groups. Group and coordinated activities will be increased throughout the Foundation's activities. For example, support for Engineering Research Centers and Advanced Scientific Computing Centers will be enhanced. New basic science and technology centers will be established in diverse research areas, including:

- Behavioral and neural sciences, which will support multidisciplinary research on the relationships between brain architecture, biochemistry, and learning, memory and information use;

- Computer and computation research, where focus will be on parallel processing, a rapidly developing approach to computer architecture;
- Materials science, which will focus on interface science and engineering, an area critically important to microelectronics and other technologies;
- Multidisciplinary research in decision and risk assessment sciences; and
- Plant sciences, through an interagency effort involving NSF and the Departments of Agriculture and Energy.

Centers, groups and other coordinated efforts contribute to the Foundation's thrusts in geosciences, biotechnology, and computer networking.

The global geosciences initiative, begun in FY 1987, is a major effort directed at problems of broad national importance and international scope. The FY 1988 Budget Request substantially augments funding for United States participation in a set of interrelated, coordinated research programs focused on the interactions among the earth's natural systems. The problems addressed are such global issues as stratospheric ozone depletion, atmospheric warming and sea level change, and deforestation. The ultimate goal is to understand the forces, both natural processes and human actions, which control the environment. Recent advances in instrumentation and technology development, including remote sensing and large scale computing, make it possible to make meaningful observations on a global scale; process large, diverse data sets; and develop more realistic global environmental models. The NSF has a lead role in this effort which involves other federal agencies, the private sector, and international organizations.

The biotechnology initiative will focus on research likely to be the foundation for the next generation of biotechnology developments. Research related to biotechnology will draw on combined expertise in biology, oceanography, risk assessment, chemistry, and engineering. Results will contribute to the understanding of the chemistry of life processes, synthesis of commercial quantities of important biological regulators, the emerging area of marine biotechnology, and better research methodologies for assessing the risk of natural and man-made processes and products.

Computer networking activities will be expanded significantly to provide a national communications resource for scientists and engineers, NSFNET. Access to advanced facilities and data bases, improved research collaboration and more rapid dissemination of results are targeted in the FY 1988 Budget Request. This networking of the general scientific research community will be implemented, along with new efforts to improve telecommunications and data sharing capability. Networking activities present a natural opportunity for university-industry collaboration. In addition to stimulating the development of new capabilities, this approach makes it possible to use new technology at a low marginal cost.

STRENGTHENING BASIC DISCIPLINARY PROGRAMS AND FACILITIES

Long-term, steady improvement in the Foundation's traditional broad support for basic disciplinary research programs and specialized facilities assures the stability and growth necessary to move forward in promising areas. It is this base which underlies subsequent advances and innovation in science and technology, often through centers and coordinated group research. The Foundation's FY 1988 Budget Request includes $1.1 billion for disciplinary programs and facilities, which provides for:

- o urgently needed increases in average grant size;
- o sustained support in disciplines where NSF has primary responsibility for the Nation's research effort;
- o expanded efforts in promising new areas; and
- o continued support for development and improvement of major research facilities and equipment.

Over the past decade, the size of awards has not kept pace with the increased costs of doing forefront research. Support for students and technicians has been especially lacking, and purchase, upgrade and maintenance of instruments has often been deferred. In FY 1988, support for graduate students will be increased, building toward a goal of on average, support for one graduate student to one principal investigator in most disciplines. Increased grant size will also provide funds for modern instrumentation and the technical support for its use and maintenance, and will permit the use of new tools and approaches such as supercomputing and remote sensing.

Research activities will be initiated or expanded in emerging areas identified as offering high promise for broad scientific insight. Some significant examples are:

- o New efforts that will focus on fundamental research needed to solve large and complex engineering systems problems and develop methodologies for modelling, designing and controlling large, non-linear, multi-variate systems;

- Expanded research in computational mathematics that will emphasize theoretical principles underlying development of computational methods; and
- Various biological subfields at the frontiers of fundamental genetics, where the research has broad implications for understanding how living systems operate and as a base for future developments in biotechnology.

The Foundation has long been a source of support for unique national research facilities. This effort continues. This investment in major research facilities serves a dual purpose: it provides resources necessary to efficiently support costly, large-scale instruments and equipment; and ensures access to such tools by individual investigators. Notably for FY 1988:

- Improvements in ground-based radar and data acquisition and analysis systems are planned at the Upper Atmospheric Research Facilities. Increased funding for the National Center for Atmospheric Research (NCAR) will allow participation of NCAR scientists in global programs, as well as the continued support of access by individual investigators to supercomputer, aircraft and radar systems.
- The current construction schedule of the Very Long Baseline Array (VLBA) will be maintained. This network of antennas extending across the continental United States, Hawaii and the Virgin Islands will surpass all existing or planned radio telescopes in resolution, range and mapping capabilities.
- Upgrading of the Illinois Microtron accelerator will begin, building on prior research and development aimed at bringing the facility to the forefront of nuclear physics research. The upgrade of the Cornell Electron Storage Ring (CESR), one of four national high energy accelerator facilities will be completed.
- The U. S. Antarctic Program includes increases necessary for improvements in logistics and research, including lease of a new research ship with icebreaking capability, refurbishment of the science laboratory at McMurdo Station, and continuation of the program for upgrading the LC-130 aircraft.

Through emphasis on education and human resources, science and technology centers and groups, and support for core disciplines and facilities, the Foundation's budget for

FY 1988 is reflective of the relationship between basic research and education in science and engineering and improved productivity and economic competitiveness. Details are provided in the budget activity summaries which follow.

ACTIVITY SUMMARIES

Mathematical and Physical Sciences

The Mathematical and Physical Sciences (MPS) Activity requests $514.0 million, an increase of $50.6 million (10.9 percent) over the FY 1987 Current Plan of $463.4 million. The FY 1988 program maintains research across the MPS disciplines, provides instrumentation and operation of major facilities, maintains number and size of individual investigator research awards, and accommodates a major thrust to broaden participation in science and engineering research.

Within the disciplinary programs:

- Mathematics will enhance support for graduate students and postdoctoral researchers and will initiate efforts aimed at revising the calculus curriculum;
- Astronomy will enhance instrumentation research and development, begin operations at the California Institute of Technology Submillimeter Observatory, and maintain the current construction schedule for the Very Long Baseline Array;
- Chemistry will support research on interfaces and thin films and enhance the chemical underpinnings of biotechnology;
- Physics will upgrade the Fly's Eye Detector at the University of Utah and support research on the physics of matter under extreme conditions;
- Materials Research will expand the Materials Research Group program, enhance instrumentation research and development, and bolster center activities.

The University of Illinois Microtron upgrade will begin, the Cornell Electron Storage Ring will be completed as will the Michigan State University Phase II upgrade, and the Indiana University Cooler Facility project will begin operations.

The MPS Activity will address human resource needs and broaden participation in all MPS disciplines by supporting additional Presidential Young Investigators, by increasing support for graduate students, and by emphasizing the research participation of women, minorities and disabled persons.

MPS will also participate in the NSF-wide effort to increase the involvement of undergraduate students and faculty in research activities and to improve the undergraduate environment through support of equipment.

Engineering

The FY 1988 Budget Request for the Engineering (ENG) Activity is $205.0 million, an increase of $42.0 million (26 percent) over the FY 1987 Current Plan of $163.0 million.

A major portion of this increase ($18 million) is for the Engineering Research Centers (ERC) program, which promotes cross-disciplinary fundamental research and education in leading technological areas important to improving the Nation's economic competitiveness, ranging from biotechnology and telecommunication to manufacturing automation and robotics. The total request of $48 million will fully support commitments to existing centers and allow five new centers to be started in FY 1988, bringing the total number supported by NSF to 21 centers.

Significant increases are planned in those on-going research programs that have the greatest potential to enhance our technological and economic competitiveness. Some of the areas included are: materials processing, which began as a joint initiative with the MPS Activity in FY 1987, automation, manufacturing systems, design, computational engineering, lightwave technology and biotechnology.

Fundamental research needed to solve large and complex engineering systems problems will be increased by $2.7 million, to a total of $5.0 million. Rational methodologies will be explored for modeling, designing and controlling non-linear, multi-variate systems such as those encountered in electric power generation and transmission, for example.

Another initiative is in neuroengineering research, for which a total of $2.0 million is requested. This program explores the potential for providing neural-like properties to engineering systems and may provide important breakthroughs in the computer, optical and electronic fields.

Programs aimed at expanding the human resource base in innovative and emerging fields of engineering are increased by $8.4 million or 40 percent. As part of this effort, the Presidential Young Investigators (PYI) program is increased from $17 million to $22 million to support 85 new faculty members, and the Engineering Initiation Awards (EIA) program is increased from $3.0 million to $5.0 million to encourage new engineering faculty members to begin research careers by providing first-time NSF support.

Another high priority is to revitalize the current engineering undergraduate curriculum by making it more responsive to the needs of industry and the engineering profession. A total of $5 million is targeted for initiation of this effort which will involve all of the engineering disciplines.

Biological, Behavioral and Social Sciences

The Biological, Behavioral, and Social Sciences (BBS) Activity requests $297.0 million for FY 1988, an increase of $38.9 million (15.1 percent) over the FY 1987 Current Plan of $258.14 million.

All subactivities will expand support for research critical to future biotechnology development, such as genetics and biochemistry, and broaden NSF activities into new areas important to future biotechnology commercialization, such as marine biotechnology.

Within the disciplinary programs:

- Molecular Biosciences will support the development and provision of new research equipment and techniques;
- Cellular Biosciences will support research applying new genetic and immunological techniques to understanding basic cellular processes;
- Biotic Systems and Resources will focus on global ecosystem dynamics and on remote sensing techniques at Long-Term Ecological Research sites, as part of the NSF-wide Global Geosciences initiative;
- Behavioral and Neural Sciences will begin a major new initiative on the neurobiology of learning, memory and information utilization; and
- Social and Economic Sciences will increase support for large scale data collection efforts and continue work on improving the accessibility and utility of government data for social science research.

BBS will establish special focus research centers and increase support for group efforts directed at multidisciplinary problems. Included will be three large biotechnology-related research centers and ten departmental facilities centers, neuroscience research centers, centers for research in decision and risk assessment sciences, and a National Center for Geographic Information Analysis. Support for Long-Term Ecological Research sites will also be expanded.

Support for undergraduate students and faculty participating in BBS research will be significantly increased. BBS will also broaden the participation of underrepresented groups, and provide new and expanded multidisciplinary training opportunities for graduate students and postdoctoral researchers.

Geosciences

The FY 1988 Budget Request for the Geosciences (GEO) Activity is $330 million, an increase of $44.9 million (15.8 percent) over the FY 1987 Current Plan of $285.1 million. The focus of this increase is on selected research areas and improvement of centers and facilities.

The major research focal point of the GEO Activity is the Global Geosciences initiative, an interrelated set of coordinated programs seeking to understand and ultimately to predict global atmospheric, oceanic, and geologic processes. Ongoing programs in atmospheric and oceanic circulation and transport, along with solid earth studies, will expand and be joined in FY 1988 by paleoclimate studies using Arctic ice cores and by research on the dynamic coupling of upper atmospheric regions.

All subactivities will strengthen their continuing programs by increasing research project support award levels and by providing increased support for instrumentation and equipment. A similar base-strengthening emphasis is represented by augmented funding for geosciences facilities, including the National Center for Atmospheric Research (NCAR), Upper Atmospheric Facilities (UAF), and Oceanographic Centers and Facilities (OCF). NCAR and UAF are key not only to atmospheric research but also constitute major national resources for other disciplines, notably the ocean sciences, and research programs of other Federal agencies, especially NASA and NOAA. Support for OCF includes establishment of an accelerator mass spectrometry center for oceanographic applications.

The GEO Activity continues to participate in the NSF initiatives in biotechnology and computational science and engineering. The Continental Lithosphere coordinated research program is funded within the GEO Activity, and in FY 1988 will expand substantially. A new coordinated research program, Storm-scale Meteorology, has evolved from prior core program activity and now will begin a concentrated effort at understanding localized severe weather phenomena, a source of much social and economic loss.

The NSF emphasis on expanding its education and human resource development activities is an integral part of the GEO Budget Request, where programs at the undergraduate, graduate, and postdoctoral levels will be strengthened, with a particular emphasis on increasing the participation of young investigators and minorities in the geosciences.

Computer and Information Science and Engineering

The FY 1988 Budget Request for the Computer and Information Science and Engineering (CISE) Activity is $143.O million, $26.4 million or 22.7 percent over the FY 1987 Current Plan of $116.5 million. This significant increase represents a major commitment of NSF to advancing U.S. leadership in the critical areas of computing and information processing.

CISE was created in FY 1986 by integrating relevant subactivities from throughout NSF. Its programs improve fundamental understanding of "information processing" in the broadest sense and enhance the training of scientists and engineers. The formation of a new Activity for these subactivities recognizes the unifying themes and overall breadth of research in CISE disciplines.

In FY 1988, CISE will pursue two main goals: fundamental research in the computer and information science disciplines, and research on and provision of advanced computing and networking capabilities. CISE will strengthen programs in a strategic way by increasing support in several especially promising thematic areas including:

o Parallel processing: Support for research in this area will be expanded throughout CISE. At least one major research center will be initiated and new parallel computers will be made available to the research community. A major effort will be begun to improve graduate and undergraduate instruction and research participation.

o Automation, robotics and intelligent systems: Several large group or "mini-center" awards will be made to encourage experimentation with large-scale systems. Upgrading instrumentation, improving laboratories, increasing student research participation and developing curricula will be undertaken.

o Design, fabrication and use of integrated microelectronics: Support for work associated with circuit and system creation and testing will increase. In cooperation with DOD, support for the service which rapidly turns microelectronic designs into chips and systems (MOSIS) will be enhanced.

The commitment to state-of-the-art advanced scientific computing will be maintained. Currently operating national supercomputer centers will be continued and technically upgraded. Access to special devices will be extended. Increased support for scientific software and training will be made available.

In the newly-established and expanded Networking and Communications subactivity, access to advanced facilities and databases, improved research collaboration and more rapid dissemination of results will be pursued. New research programs and the implementation of NSFNET will be focuses of the subactivity.

The FY 1988 Budget Request allows CISE to shape the rapidly developing area of computing and information processing, an area with wide implications for research and productivity in all fields.

Scientific, Technological and International Affairs

The Scientific, Technological and International Affairs (STIA) Activity has a Budget Request for FY 1988 of $51.0 million, which is an increase of $7.3 million (17 percent) over the FY 1987 Current Plan amount of $43.7 million.

STIA's activities cut across all the scientific and engineering disciplines in the Foundation, often responding to executive and legislative mandates, as well as providing services to the science and engineering community. In addition, STIA serves as a management focal point for many of the cross-disciplinary programs which are funded by research activities in NSF.

The largest component of the FY 1988 Request consists of $19.4 million required by Public Law 99-443 for the Small Business Innovation Research (SBIR) program. The increase of $2.6 million for SBIR accounts for 36 percent of the FY 1988 Activity's increase.

STIA has traditionally focused programs on studying or expanding the human resource base. For instance, the Science Resources Studies Subactivity plans to expand areas covered by their current data bases for more complete analyses of the Nation's pipeline of scientists and engineers. Such research is critical for understanding the predicted shortages of students and faculty in such disciplinary fields as engineering.

The Research Initiation and Improvement Subactivity focuses its efforts toward groups underrepresented in science and engineering. For FY 1988, a new initiative, Research

Career Opportunities, will support efforts to encourage decisions by members of underrepresented groups for pursuing science and engineering studies. Expansion of the Visiting Professorships for Women program is also planned.

In the area of economic competitiveness, the Policy Research and Analysis Subactivity plans to support studies of the role played by research in U.S. competitiveness. In a similar vein, in international activities, STIA plans to develop a set of cooperative activities between the U.S. and Japan with the aim of increasing the participation by U.S. scientists and engineers at Japanese research institutions.

Program Development and Management

The Program Development and Management (PD&M) Activity increases by $15.9 million to $95.0 million, a 20.1 percent increase over the adjusted FY 1987 Current Plan. This Activity accounts for 5% of the Foundation's total FY 1988 request and provides funds for staff salaries and other operating expenses necessary to manage and administer the Foundation's program responsibilities.

The increase for PD&M is best characterized as follows:

- The $8.17 million increase in mandatory costs includes full funding for the Foundation's 1,174 full-time equivalent positions (FTEs), the agency's contribution to the new Federal Retirement System, a rise in GSA rental costs and expenditures related to the acquisition of a new mainframe computer, which is expected in late FY 1987.

- An increase of $5.9 million for capital improvements will provide first-year costs for a voice/data transmission system, and further integration of our distributed information system. Also included in this category are funds to improve our space utilization and environment by renovations and improvements to our building facility.

- Finally, the programmatic increases in FY 1988 will require an additional 30 FTEs (for a total of 1,204) with commensurate benefits and support costs totalling $1.8 million.

United States Antarctic Program

The FY 1988 Budget Request for the U. S. Antarctic Program is $143 million, an increase of $25.9 million (22.1 percent) over the FY 1987 Current Plan of $117.1 million. A strong U. S. presence via substantial research activities in Antarctica continues as the program's objective.

While research support to investigators increases modestly to maintain the current level of activity and to carry out selected new projects, there is a substantial increase in the Activity for additions to laboratory facilities and for rehabilitation of aircraft. Funds also are requested for a major improvement to research capability by the lease and outfitting of a research vessel with ice-breaking capability.

That the Antarctic affords a unique natural laboratory has been reaffirmed by the recent discovery of seasonal ozone depletion in its stratosphere. It is increasingly clear that the Antarctic continent, ocean and atmosphere will play a significant role in the understanding of global phenomena.

Science and Engineering Education

The FY 1988 Budget Request for Science and Engineering Education (SEE) is $115.0 million or $15.96 million (16.1%) over the FY 1987 Current Plan of $99.04 million.

Funds for precollege science and mathematics education will provide continued support for teacher preparation and enhancement, materials development, and informal science education. Special attention will be given to application of advanced technologies in science and mathematics education. Enrichment activities for talented high school students will be initiated to stimulate interest in science and engineering careers.

Within the SEE Activity, undergraduate efforts will have an instruction-related focus. The College Science Instrumentation Program will continue to emphasize laboratory improvement and new approaches to laboratory instruction. New faculty development efforts will promote diffusion of recent scientific and technical developments into undergraduate instruction.

The number of new three-year Graduate Fellowships awarded will be increased from 560 to 760 in FY 1988, for a total of more than 1700 new and continuing fellows supported. These awards recognize the Nation's most talented graduate students in science and engineering.

Special attention will be given to activities to increase the participation of women, minorities, and disabled persons in science and engineering careers, including establishment of resource centers at institutions with significant minority enrollment.

Research in teaching and learning, together with systematic assessment of the quality and impact of NSF science and engineering education programs, receive increased emphasis in FY 1988.

Cross-Directorate Activities

The Foundation focuses attention on significant issues that cut across disciplines through coordinated efforts in all NSF Activities. In particular, in FY 1988 the Foundation will expand cross-directorate activities that: 1) address research and education in science, mathematics and engineering, at the undergraduate level; and 2) support broadened participation by all groups, regions and institutions.

Management of cross-directorate activities is distributed, and closely coupled with the ongoing functions and responsibilities of each Activity. In this way, concerns are addressed in the context of disciplinary-specific problems and needs. At the same time, Foundation-wide coordination provides the framework for developing overall policies and goals for these efforts.

Funding targets established for these activities are consistently exceeded, and many scientists and engineers who initiated research through these focused programs are gaining continued support in other programs.

In FY 1988 the Foundation's emphasis on undergraduate activities will expand earlier efforts and support cross-directorate initiatives for undergraduate science, mathematics and engineering research and education:

- The Research Experiences for Undergraduates (REU) program was initiated in FY 1987 with a funding target of $9 million. REU provides hands-on research experience to undergraduate students. Over 2000 students will participate at selected sites or in conjunction with ongoing NSF research projects. In FY 1988 additional efforts will be initiated for undergraduate faculty enhancement, laboratory instrumentation and curriculum development. Over $40 million is targeted for these cross-directorate undergraduate activities in FY 1988. In addition, $9.5 million will support instructional equipment through the College Science Instrumentation Program in the SEE Activity.

- Predominantly Undergraduate Institutions (PUI) support will increase to over $50 million in FY 1988. This includes all NSF science and engineering research awards to predominantly undergraduate colleges and universities. Included within this general category of support are Research in Undergraduate Institutions (RUI) awards at non-doctorate degree granting institutions and departments, and Research Opportunity Awards (ROA) which permit faculty members from undergraduate institutions to participate in research at major research universities.

Cross-directorate activities for developing human resources and broadening participation in science and engineering will be expanded:

- Minority Research Initiation (MRI) supports minority scientists and engineers who have not previously received federal research support. FY 1988 funding for MRI will increase to over $2.9 million. In FY 1986, an MRI planning grant component was initiated to support preliminary studies or other activities related to development of research proposals. The fifteen planning awards included twelve in fields where minorities are most severely underrepresented.

- Research Opportunities for Women (ROW) funding will increase to more than $2.7 million. In FY 1986, ROW underwent extensive review, resulting in a reformulation of the program. The original emphasis on research initiation has been augmented in FY 1987 to include support for research planning grants, and for career advancement awards to enable women to expand their research efforts. With these changes ROW will better address the barriers to productive research careers.

  MRI and ROW complement focused programs for underrepresented groups and for minority institutions centrally managed in the STIA and SEE Activities, as well as disciplinary-oriented efforts in other Activities. Taken together, NSF efforts directed toward increasing the participation of underrepresented groups will provide about $28 million in FY 1988.

- The Experimental Program to Stimulate Competitive Research (EPSCoR) will increase 30 percent to $6 million in FY 1988, for continuing commitments to eight states and territories that received new awards in FY 1986: Alabama, Kentucky, North Dakota, Nevada, Oklahoma, Puerto Rico, Vermont and Wyoming. EPSCoR features State, academic and private sector involvement in improving competitive stature in science and engineering.

- Presidential Young Investigator (PYI) awards provide research support to promising young science and engineering faculty members. NSF support is intended to encourage young investigators (within four years beyond the Ph.D.) to select and remain in academic careers. The program also fosters industry-university cooperation and leverages federal funds by offering support to match industrial contributions. In both FY 1987 and FY 1988, 200 new awards will be made, bringing the total number of PYIs to about 900. In FY 1988 funding is projected to increase to about $50 million. Since initiation of the program in FY 1984, over $27 million in funds to match private sector contributions have been provided.

Special Foreign Currency

Because few excess currencies remain, OMB has directed that agencies no longer request budget authority for special foreign currency program appropriations. Accordingly, no appropriations are requested for the Special Foreign Currency activity in FY 1988, nor is a separate activity summary presented. The Special Foreign Currency Program will be terminated at the end of FY 1987 and any unobligated balances remaining in the Special Foreign Currency Appropriation at the end of FY 1987 will be withdrawn.

EXPLANATION OF PRIOR YEAR CARRYOVER

In addition to the FY 1987 appropriations, unobligated balances totaling $1,613,742 are available for obligation in FY 1987. The sources of these funds are:

- No-Year Funds - Prior to FY 1974, NSF appropriations were made on a no-year basis and unobligated funds were available until expended. As a result of the deobligations in FY 1985 and FY 1986 of obligations made in previous years, there is a balance of $62,030 available for obligation in FY 1987.

- The unobligated balance of the FY 1986 Research and Related Activities Appropriation is $1,410,215. The balance consists primarily of amounts intended for the funding of two large awards in the Social and Economic Sciences Program and one large award in the International Scientific Cooperative Activities program which for technical reasons could not be obligated by the end of FY 1986. The FY 1987 Current Plan reflects the use of these funds in the manner planned in FY 1986.

- The unobligated balance of the FY 1986 Science and Engineering Education Activities appropriation is $35,693 and results from carryover balances in two programs. The Research, Studies and Program Assessments subactivity carried forward a balance of $10,693 and the Materials Development and Informal Science Education program carried forward a balance of $25,000. The unobligated funds will be used in FY 1987 for the activities planned in FY 1986.

- United States Antarctic Program - A total of $80,617 remained unobligated at the end of FY 1986 and will be available for use during FY 1987.

- Special Foreign Currency - A total of $25,187 of unobligated FY 1986 funds will be used in the FY 1987 program.

BUDGET SUMMARY OF OBLIGATIONS BY ACTIVITY AND SUBACTIVITY SHOWING DOLLAR AND PERCENTAGE CHANGES: FY 1988/FY 1987

	Actual FY 1986	Current Plan FY 1987	Estimate FY 1988	Difference FY 1988/1987	
				Amount	Percent
MATHEMATICAL AND PHYSICAL SCIENCE					
Mathematical Sciences	$51,928	$59,800	$67,800	$8,000	13.4%
Astronomical Sciences	80,151	85,060	92,560	7,500	8.8%
Physics	113,172	117,199	131,330	14,131	12.1%
Chemistry	85,745	93,487	102,750	9,263	9.9%
Materials Research	104,314	108,599	119,560	10,961	10.1%
Reduction for 1987 Pay Supplemental	-0-	(768)*	-0-	768	N.A
Total, MPS	***435,310***	***463,377***	***514,000***	***50,623***	***10.9%***
ENGINEERING					
Chemical, Biochemical, and Thermal Engineering	27,708	28,400	31,483	3,083	10.9%
Mechanics, Structures, and Materials Engineering	22,674	24,900	28,520	3,620	14.5%
Electrical, Communications and Systems Engineering	19,813	22,536	28,400	5,864	26.0%
Design, Manfuacturing and Computer-Integrated Engineering	12,775	14,000	17,970	3,970	28.4%
Emerging Engineering Technologies	10,356	15,640	19,380	3,740	23.9%
Critical Engineering Systems	23,846	24,560	27,747	3,187	13.0%
Cross-Disciplinary Research	27,735	33,000	51,500	18,500	56.1%
Reduction for 1987 Pay Supplemental	-0-	(271)*	-0-	271	N.A.
Total, ENG.	***144,907***	***162,765***	***205,000***	***42,235***	***25.9%***
BIOLOGICAL, BEHAVIORAL & SOCIAL SCIENCES					
Molecular Biosciences	59,645	62,324	73,751	11,427	18.3%
Cellular Biosciences	49,965	52,219	60,589	8,370	16.0%
Biotic Systems and Resources	58,265	63,330	72,810	9,480	15.0%
Behavioral and Neural Sciences	43,623	47,426	53,816	6,390	13.5%
Social and Economic Science	27,794	32,840	36,034	3,194	9.7%
Reduction for 1987 Pay Supplemental	-0-	(425)*	-0-	425	N.A.
Total, BBS	***239,292***	***257,714***	***297,000***	***39,286***	***15.2%***
GEOSCIENCES					
Atmospheric Sciences	92,580	93,428	106,700	13,272	14.2%
Earth Sciences	46,827	49,862	63,350	13,488	27.1%
Ocean Sciences	119,424	133,660	149,450	15,790	11.8%
Arctic Research Program	8,034	8,109	10,500	2,391	29.5%
Reduction for 1987 Pay Supplemental	-0-	(471)*	-0-	471	N.A
Total, GEO	***266,865***	***284,588***	***330,000***	***45,412***	***16.0%***
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
Computer and Computation Research	33,482	35,442	43,351	7,909	22.3%
Information Robotics and Intelligent Systems	15,093	16,841	19,870	3,029	18.0%
Microelectronic Information Processing Systems	7,278	11,563	18,214	6,651	57.5%
Advanced Scientific Computing	36,468	42,890	48,200	5,310	12.4%
Networking and Communications Research and Infrastructure	8,559	9,853	13,365	3,512	35.6%
Reduction for 1987 Pay Supplemental	-0-	(193)*	-0-	193	—
Total, CISE	***100,880***	***116,396***	***143,000***	***26,604***	***22.9%***
SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS					
Industrial Science and Technological Innovation	15,224	16,779	19,413	2,634	15.7%
International Cooperative Scientific Activities	10,222	10,282	11,964	1,682	16.4%
Policy Research and Analysis	1,828	1,846	2,000	154	8.3%
Science Resources Studies	3,853	3,857	5,233	1,376	35.7%
Research Initiation and Improvement	7,096	10,990	12,390	1,400	12.7%
Reduction for 1987 Pay Supplemental	-0-	(72)*	-0-	72	—
Total, STIA	***38,223***	***43,682***	***51,000***	***7,318***	***16.8%***
PROGRAM DEVELOPMENT AND MANAGEMENT	71,836	79,100	95,000	15,900	20.1%
TOTAL, RESEARCH AND RELATED ACTIVITIES	***1,297,313***	***$1,407,622***	***$1,635,000***	***$227,378***	***16.2%***

BUDGET SUMMARY OF OBLIGATIONS BY ACTIVITY AND SUBACTIVITY SHOWING DOLLAR AND PERCENTAGE CHANGES: FY 1988/FY 1987

	Actual FY 1986	Current Plan FY 1987	Estimate FY 1988	Difference FY 1988/1987 Amount	Percent
U.S. ANTARCTIC PROGRAM					
U.S. Antarctic Research Prog.	$11,016	$12,500	$13,500	$1,000	8.0%
Operations Support	99,145	104,581	129,500	24,919	23.8%
Total, USAP	***110,161***	***117,081***	***143,000***	***25,919***	***22.1%***
SCIENCE AND ENGINEERING EDUCATION					
Teacher Preparation and Enhancement	26,257	30,500	36,000	5,500	18.0%
Materials Development, Research and Informal Science Education	24,356	29,525	0	(29,525)	-100.0%
Materials Development and Informal Science Education	0	0	26,000	26,000	N/A
College Science Instrumentation	5,259	9,500	9,500	0	0.0%
Research Career Development	25,938	27,300	36,000	8,700	31.9%
Studies and Program Assessment	2,785	2,211	0	(2,211)	-100.0%
Research, Studies and Program Assessment	0	0	7,500	7,500	N/A
Total, SEE	***84,595***	***99,036***	***115,000***	***15,964***	***16.1%***
SPECIAL FOREIGN CURRENCY	1,098	725	0	(725)	-100.0%
TOTAL, NATIONAL SCIENCE FOUNDATION	***$1,493,167***	***$1,624,464***	***$1,893,000***	***$268,537***	***16.5%***

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

SUMMARY BUDGET INFORMATION BY SUBACTIVITY, ACTIVITY AND APPROPRIATION: FY 1986-FY 1988

	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
RESEARCH AND RELATED ACTIVITIES					
Mathematical and Physical Sciences	435,310,083	489,870,000	463,377,000	514,000,000	50,623,000
Engineering	144,906,933	172,470,000	162,765,000	205,000,000	42,235,000
Biological, Behavioral and Social Sciences	239,292,092	270,500,000	257,714,245	297,000,000	39,285,755
Geosciences	266,865,492	298,150,000	284,588,000	330,000,000	45,412,000
Computer and Information Science and Engineering	100,879,284	122,980,000	116,396,000	143,000,000	26,604,000
Scientific, Technological and International Affairs	38,223,465	47,030,000	43,682,000	51,000,000	7,318,000
Program Development and Management	71,836,106	78,000,000	79,100,000	95,000,000	15,900,000
Subtotal, RRA	1,297,313,455	1,479,000,000	1,407,622,245	1,635,000,000	227,377,755
Unobligated Balances and Other Adjustments	(3,253,455)		(1,472,245)		1,472,245
Research and Related Activities Appropriation	***1,294,060,000***	***1,479,000,000***	***1,406,150,000***	***1,635,000,000***	***228,850,000***
U.S. ANTARCTIC RESEARCH PROGRAM					
U.S. Antarctic Research Program	11,016,352	12,000,000	12,500,000	13,500,000	1,000,000
Operations Support Program	99,144,459	105,000,000	104,580,617	129,500,000	24,919,383
Subtotal, U.S. Antarctic Program Activities	110,160,811	117,000,000	117,080,617	143,000,000	25,919,383
Unobligated Balance and Other Adjustments	(9,811)		(80,617)		80,617
U.S. Antarctic Program Appropriation	***110,151,000***	***117,000,000***	***117,000,000***	***143,000,000***	***26,000,000***
SCIENCE AND ENGINEERING EDUCATION ACTIVITIES APPROPRIATION					
Teacher Preparation and Enhancement	26,256,302	27,000,000	30,500,000	36,000,000	5,500,000
Materials Development, Research and Informal Science Education	24,356,300	25,000,000	29,525,000	0	(29,525,000)
Materials Development and Informal Science Education	0	0	0	26,000,000	26,000,000
College Science Instrumentation	5,259,080	7,500,000	9,500,000	9,500,000	0
Research Career Development	25,937,980	27,300,000	27,300,000	36,000,000	8,700,000
Studies and Program Assessment	2,785,179	2,200,000	2,210,693	0	(2,210,693)
Research, Studies and Program Assessment	0	0	0	7,500,000	7,500,000
Subtotal, Science and Engineering Education Activites	84,594,841	89,000,000	99,035,693	115,000,000	15,964,307
Unobligated Balance and Other Adjustments	(31,433,841)		(35,693)		35,693
Science and Engineering Education Activities Appropriation	***53,161,000***	***89,000,000***	***99,000,000***	***115,000,000***	***16,000,000***
SPECIAL FOREIGN CURRENCY APPROPRIATION					
Special Foreign Currency Program	1,098,263	700,000	725,187	0	(725,187)
Unobligated Balances and Other Adjustments	(141,263)		(25,187)		25,187
Special Foreign Currency Appropriation	***957,000***	***700,000***	***700,000***	***0***	***(700,000)***
TOTAL, NSF APPROPRIATION	***$1,458,329,000***	***$1,685,700,000***	***$1,622,850,000***	***$1,893,000,000***	***$270,150,000***

LEVEL OF FUNDING BY PROGRAM

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
MATHEMATICAL AND PHYSICAL SCIENCES					
MATHEMATICAL SCIENCES					
Classical Analysis	$5,008,816	$5,767,000	$5,515,000	$5,784,000	$269,000
Modern Analysis	5,091,681	5,861,000	5,507,000	5,774,000	267,000
Geometric Analysis	5,020,311	5,692,000	5,586,000	5,857,000	271,000
Topology and Foundations	6,146,849	7,085,000	6,690,000	7,014,000	324,000
Algebra and Number Theory	8,519,334	9,868,000	9,333,000	9,786,000	453,000
Applied Mathematics	6,999,329	8,907,000	7,566,000	7,895,000	329,000
Statistics and Probability	6,269,588	7,440,000	6,823,000	7,130,000	307,000
Computational Mathematics	0	0	3,000,000	4,600,000	1,600,000
Special Projects	8,872,239	9,180,000	9,780,000	13,960,000	4,180,000
Total	***51,928,147***	***59,800,000***	***59,800,000***	***67,800,000***	***8,000,000***
ASTRONOMICAL SCIENCES					
Astronomy Project Support	26,450,198	27,700,000	27,519,000	29,510,000	1,991,000
National Astronomy and Ionosphere Center	5,720,248	6,100,000	5,901,000	6,300,000	399,000
National Optical Astronomy Observatories	22,711,778	24,200,000	23,145,000	25,800,000	2,655,000
National Radio Astronomy Observatory	25,269,014	27,060,000	28,495,000	30,950,000	2,455,000
Total	***80,151,238***	***85,060,000***	***85,060,000***	***92,560,000***	***7,500,000***
PHYSICS					
Elementary Particle Physics	39,706,973	45,690,000	42,052,000	46,130,000	4,078,000
Intermediate Energy Nuclear Physics	17,520,998	18,800,000	17,699,000	21,220,000	3,521,000
Nuclear Physics	20,482,899	21,220,000	20,815,000	22,250,000	1,435,000
Atomic, Molecular, and Plasma Physics	13,324,927	13,930,000	13,401,000	14,790,000	1,389,000
Theoretical Physics	14,405,201	15,970,000	14,748,000	16,510,000	1,762,000
Gravitational Physics	7,731,043	11,030,000	8,484,000	10,430,000	1,946,000
Total	***113,172,041***	***126,640,000***	***117,199,000***	***131,330,000***	***14,131,000***
CHEMISTRY					
Analytical and Surface Chemistry	11,481,000	12,294,000	11,682,000	12,310,000	628,000
Inorganic, Bioinorganic and Organomettalic Chemistry	14,156,000	15,337,000	14,439,000	15,368,000	929,000
Organic and Macromolecular Chemistry	21,243,000	23,708,000	22,688,000	24,120,000	1,432,000
Physical Chemistry	27,298,000	29,642,000	28,304,000	29,942,000	1,638,000
Special Projects	3,580,064	6,982,000	6,362,000	10,998,000	4,636,000
Chemical Instrumentation	7,987,000	13,057,000	10,012,000	10,012,000	0
Total	***85,745,064***	***101,020,000***	***93,487,000***	***102,750,000***	***9,263,000***
MATERIALS RESEARCH					
Solid State Physics	11,536,764	12,370,000	11,880,000	12,880,000	1,000,000
Solid State Chemistry	8,334,156	9,100,000	8,630,000	9,610,000	980,000
Low Temperature Physics	7,831,225	8,520,000	8,060,000	8,770,000	710,000
Condensed Matter Theory	8,198,562	9,470,000	8,730,000	10,220,000	1,490,000
Metallurgy	9,338,478	10,180,000	9,560,000	10,500,000	940,000
Ceramics and Electronic Materials	6,301,436	6,860,000	6,460,000	7,180,000	720,000
Polymers	6,903,368	7,460,000	7,250,000	7,980,000	730,000
Instrumentation for Materials Research	5,746,673	6,240,000	5,000,000	5,300,000	300,000
Materials Research Laboratories	25,706,146	27,700,000	26,500,000	27,800,000	1,300,000
National Facilities	9,907,771	10,650,000	10,500,000	11,300,000	800,000
Materials Research Groups	4,509,014	8,800,000	6,029,000	8,020,000	1,991,000
Total	***104,313,593***	***117,350,000***	***108,599,000***	***119,560,000***	***10,961,000***
SUBTOTAL, MPS	***435,310,083***	***489,870,000***	***464,145,000***	***514,000,000***	***49,855,000***
REDUCTION FOR 1987 PAY SUPPLEMENTAL			(768,000)*		768,000
TOTAL, MPS	***$435,310,083***	***$489,870,000***	***$463,377,000***	***$514,000,000***	***$50,623,000***

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
ENGINEERING					
CHEMICAL, BIOCHEMICAL, AND THERMAL ENGINEERING					
Kinetics and Catalysis Engineering	$3,008,546	$3,340,000	$3,140,000	$3,480,000	$340,000
Biochemical and Biomass Engineering	2,797,843	2,560,000	2,780,000	3,080,000	300,000
Process and Reaction Engineering	3,573,121	3,710,000	3,610,000	3,980,000	370,000
Multiphase and Interfacial Phenomena	3,113,355	3,560,000	3,270,000	3,630,000	360,000
Separation and Purification Processes	2,890,753	3,240,000	3,030,000	3,380,000	350,000
Thermodynamics and Transport Phenomena	4,356,447	4,750,000	4,570,000	5,050,000	480,000
Thermal Systems and Engineering	7,960,076	9,050,000	8,000,000	8,883,000	883,000
Total	*27,700,141*	*30,210,000*	*28,400,000*	*31,483,000*	*3,083,000*
MECHANICS, STRUCTURES, AND MATERIALS ENGINEERING					
Solid and Geomechanics	5,838,548	6,470,000	6,100,000	6,850,000	750,000
Structures and Building Systems	3,572,956	3,610,000	3,800,000	4,300,000	500,000
Fluid Dynamics and Hydraulics	5,509,723	6,130,000	5,600,000	6,220,000	620,000
Tribology	1,777,197	2,150,000	1,900,000	2,260,000	360,000
Dynamic Systems and Control	2,794,035	2,910,000	3,000,000	3,400,000	400,000
Materials Engineering and Processing	3,181,813	5,000,000	4,500,000	5,490,000	990,000
Total	*22,674,272*	*26,270,000*	*24,900,000*	*28,520,000*	*3,620,000*
ELECTRICAL, COMMUNICATIONS, AND SYSTEMS ENGINEERING					
Solid State and Microstructures	7,084,479	7,250,000	7,270,000	8,500,000	1,230,000
Systems Theory and Operations Research	5,036,787	5,400,000	4,860,000	5,350,000	490,000
Quantum Electrical, Waves and Beams	4,630,755	4,980,000	4,650,000	5,150,000	500,000
Large Scale Non-Linear Systems	0	0	2,300,000	5,000,000	2,700,000
Instrumentation, Sensing and Measurement	3,061,303	3,140,000	3,456,000	4,400,000	944,000
Total	*19,813,324*	*20,770,000*	*22,536,000*	*28,400,000*	*5,864,000*
DESIGN, MANUFACTURING, AND COMPUTER-INTEGRATED ENGINEERING					
Design Theory and Methodology	2,721,978	3,200,000	2,980,000	3,820,000	840,000
Computer-Integrated Engineering	2,306,017	2,250,000	2,590,000	3,370,000	780,000
Manufacturing Systems	5,069,603	5,270,000	5,540,000	7,090,000	1,550,000
Automation and Systems Integration	2,677,687	3,450,000	2,890,000	3,690,000	800,000
Total	*12,775,285*	*14,170,000*	*14,000,000*	*17,970,000*	*3,970,000*
EMERGING ENGINEERING TECHNOLOGIES					
Biotechnology	3,025,073	5,000,000	4,600,000	5,550,000	950,000
Bioengineering and Research to Aid the Handicapped	4,335,639	5,060,000	4,340,000	4,830,000	490,000
Computational Engineering	0	3,000,000	2,500,000	3,000,000	500,000
Lightwave Technology	2,994,791	3,230,000	3,200,000	4,000,000	800,000
Neuroengineering	0	0	1,000,000	2,000,000	1,000,000
Subtotal	*10,355,503*	*16,290,000*	*15,640,000*	*19,380,000*	*3,740,000*
CRITICAL ENGINEERING SYSTEMS					
Earthquake Hazard Mitigation	14,548,214	16,500,000	15,100,000	16,700,000	1,600,000
Environmental Engineering	4,203,082	4,420,000	4,000,000	4,377,000	377,000
Systems Engineering for Large Structures	2,745,694	3,120,000	3,000,000	3,500,000	500,000
Natural and Man-Made Hazard Mitigation	2,348,999	2,720,000	2,460,000	3,170,000	710,000
Subtotal	*23,845,989*	*26,760,000*	*24,560,000*	*27,747,000*	*3,187,000*
CROSS-DISCIPLINARY RESEARCH					
Engineering Research Centers	21,893,711	35,000,000	30,000,000	48,000,000	18,000,000
Industry/University Research Projects	2,965,438	0	0	0	0
Industry/University Research Centers	2,875,291	3,000,000	3,000,000	3,500,000	500,000
Total	*27,734,440*	*38,000,000*	*33,000,000*	*51,500,000*	*18,500,000*
SUBTOTAL, ENGINEERING	*144,906,933*	*172,470,000*	*163,036,000*	*205,000,000*	*41,964,000*
REDUCTION FOR 1987 PAY SUPPLEMENTAL			(271,000)*		271,000
TOTAL, ENGINEERING	*$144,906,933*	*$172,470,000*	*$162,765,000*	*$205,000,000*	*$42,235,000*

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
BIOLOGICAL, BEHAVIORAL, AND, SOCIAL SCIENCES					
MOLECULAR BIOSCIENCES					
Biological Instrumentation	$8,722,908	$10,000,000	$9,375,000	$13,675,000	$4,300,000
Biochemistry	14,174,866	16,090,000	14,850,622	16,638,000	1,787,378
Biophysics	13,753,149	15,800,000	14,678,000	16,538,000	1,860,000
Prokaryotic Genetics	8,932,487	9,660,000	8,974,000	10,974,000	2,000,000
Metabolic Biology	14,062,018	15,550,000	14,446,000	15,926,000	1,480,000
Total	***59,645,428***	***67,100,000***	***62,323,622***	***73,751,000***	***11,427,378***
CELLULAR BIOSCIENCES					
Cell Biology	10,485,902	12,180,000	11,242,000	12,574,000	1,332,000
Cellular Physiology	8,190,899	9,020,000	8,325,000	9,957,000	1,632,000
Developmental Biology	13,134,449	14,970,000	13,804,000	14,936,000	1,132,000
Eukaryotic Genetics	8,902,248	10,040,000	9,267,000	12,409,000	3,142,000
Regulatory Biology	9,171,205	10,380,000	9,581,000	10,713,000	1,132,000
Total	***49,884,703***	***56,590,000***	***52,219,000***	***60,589,000***	***8,370,000***
BIOTIC SYSTEMS AND RESOURCES					
Ecology	9,234,055	10,930,000	10,384,000	11,854,000	1,470,000
Ecosystem Studies	17,576,934	20,790,000	19,646,000	24,086,000	4,440,000
Systematic Biology	12,164,399	13,450,000	12,899,000	14,669,000	1,770,000
Population Biology and Physiological Ecology	10,173,603	11,180,000	10,781,000	11,961,000	1,180,000
Biological Research Resources	9,116,509	10,160,000	9,620,000	10,240,000	620,000
Total	***58,265,500***	***66,510,000***	***63,330,000***	***72,810,000***	***9,480,000***
BEHAVIORAL AND NEURAL SCIENCES					
Anthropology	7,322,527	7,780,000	7,580,000	8,220,000	640,000
Linguistics	2,756,370	3,300,000	3,200,000	3,490,000	290,000
Memory and Cognitive Processes	3,599,465	4,200,000	4,000,000	4,300,000	300,000
Social and Developmental Psychology	2,869,505	3,300,000	3,200,000	3,480,000	280,000
Developmental Neuroscience	5,261,089	6,150,000	5,960,000	6,800,000	840,000
Integrative Neural Systems	4,742,184	5,500,000	5,470,000	7,200,000	1,730,000
Molecular and Cellular Neurobiology	5,225,141	6,150,000	6,060,000	6,700,000	640,000
Psychobiology	5,180,594	5,030,000	5,030,000	6,300,000	1,270,000
Sensory Physiology and Perception	6,665,808	7,460,000	6,926,000	7,326,000	400,000
Total	***43,622,683***	***48,870,000***	***47,426,000***	***53,816,000***	***6,390,000***
SOCIAL AND ECONOMIC SCIENCE					
Economics	10,558,991	12,600,000	12,680,000	13,422,000	742,000
Geography	1,449,499	1,680,000	1,722,000	2,922,000	1,200,000
Sociology	3,492,465	3,800,000	3,840,000	4,115,000	275,000
Measurement Methods and Data Improvement	3,294,633	3,700,000	3,740,000	3,940,000	200,000
History and Philosophy of Science	1,737,989	1,750,000	1,790,000	1,965,000	175,000
Political Science	3,494,087	3,800,000	3,840,000	4,615,000	775,000
Law and Social Sciences	1,851,960	1,750,000	1,790,000	2,040,000	250,000
Decision, Risk and Management Science	1,914,094	2,350,000	2,390,000	3,015,000	625,000
Subtotal	***27,793,718***	***31,430,000***	***31,792,000***	***36,034,000***	***4,242,000***
**FY 1986 Carryover			1,048,623		(1,048,623)
Total	***27,793,718***	***31,430,000***	***32,840,623***	***36,034,000***	***3,193,377***
SUBTOTAL, BBS	***239,212,032***	***270,500,000***	***258,139,245***	***297,000,000***	***38,860,755***
REDUCTION FOR 1987 PAY SUPPLEMENTAL			(425,000)*		425,000
TOTAL, BBS	***$239,212,032***	***$270,500,000***	***$257,714,245***	***$297,000,000***	***$39,285,755***

Amount to be transferred to the PO&M activity, upon approval of the requested increase in the FY 1987 PO&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

*****FY 1986 carryover in BBS of funds to FY 1987.***

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
GEOSCIENCES					
ATMOSPHERIC SCIENCES					
Atmospheric Sciences Project Support	$47,605,448	$51,326,000	$48,108,000	$54,800,000	$6,692,000
National Center for Atmospheric Research	40,966,010	45,191,000	41,220,000	47,100,000	5,880,000
Upper Atmospheric Facilities	4,008,407	4,133,000	4,100,000	4,800,000	700,000
Total	***92,579,865***	***100,650,000***	***93,428,000***	***106,700,000***	***13,272,000***
EARTH SCIENCES					
Earth Sciences Project Support	32,512,469	35,700,000	34,252,000	38,250,000	3,998,000
Instrumentation and Facilities	4,758,719	5,000,000	5,050,000	6,050,000	1,000,000
Continental Lithosphere	9,555,768	14,250,000	10,560,000	19,050,000	8,490,000
Total	***46,826,956***	***54,950,000***	***49,862,000***	***63,350,000***	***13,488,000***
OCEAN SCIENCES					
Ocean Sciences Research Support	56,877,014	66,438,000	66,438,000	74,290,000	7,852,000
Oceanographic Centers and Facilities	33,697,028	37,172,000	37,172,000	43,860,000	6,688,000
Ocean Drilling Program	28,849,999	30,050,000	30,050,000	31,300,000	1,250,000
Total	***119,424,041***	***133,660,000***	***133,660,000***	***149,450,000***	***15,790,000***
ARCTIC RESEARCH PROGRAM					
Arctic Research Projects	7,749,107	8,390,000	7,644,000	10,000,000	2,356,000
Arctic Research Commission	285,523	500,000	465,000	500,000	35,000
Total	***8,034,630***	***8,890,000***	***8,109,000***	***10,500,000***	***2,391,000***
SUBTOTAL GEOSCIENCES	***266,865,492***	***298,150,000***	***285,059,000***	***330,000,000***	***44,941,000***
DIRECTORATE CONTRIBUTION TO PAY SUPPL.	0	0	(471,000)*	0	471,000
TOTAL GEOSCIENCES	***$266,865,492***	***$298,150,000***	***$284,588,000***	***$330,000,000***	***$45,412,000***

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTER AND COMPUTATION RESEARCH					
Computer and Computation Theory	$5,235,911	$5,500,000	$5,500,000	$6,500,000	$1,000,000
Numeric & Symbolic Computation	1,483,185	2,500,000	2,500,000	3,500,000	1,000,000
Computer Systems Architecture	3,163,769	2,980,000	3,200,000	3,851,000	651,000
Software Systems	4,986,412	5,400,000	5,400,000	6,400,000	1,000,000
Software Engineering	2,114,462	3,400,000	2,310,000	3,100,000	790,000
CISE Institutional Infrastructure	14,260,923	14,700,000	14,300,000	17,000,000	2,700,000
CISE Instrumentation	2,237,291	2,500,000	2,232,000	3,000,000	768,000
Total	**33,481,953**	**36,980,000**	**35,442,000**	**43,351,000**	**7,909,000**
INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS					
Knowledge & Database Systems	5,822,635	7,100,000	6,584,000	7,800,000	1,216,000
Robotics & Machine Intelligence	4,782,669	4,700,000	5,329,000	6,320,000	991,000
Interactive Systems	2,379,047	2,000,000	2,513,000	2,900,000	387,000
Information Impact	2,108,446	2,500,000	2,415,000	2,850,000	435,000
Total	**15,092,797**	**16,300,000**	**16,841,000**	**19,870,000**	**3,029,000**
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS					
Design, Tools & Test	1,102,507	2,600,000	2,574,000	3,300,000	726,000
Microelectronic Systems Architecture	1,594,330	2,600,000	2,322,000	3,300,000	978,000
Circuits and Signal Processing	2,863,603	3,000,000	2,976,000	3,400,000	424,000
Experimental Systems	893,760	2,000,000	2,322,000	4,814,000	2,492,000
Systems Prototyping & Fabrication	823,636	2,000,000	1,369,000	3,400,000	2,031,000
Total	**7,277,836**	**12,200,000**	**11,563,000**	**18,214,000**	**6,651,000**
ADVANCED SCIENTIFIC COMPUTING					
Supercomputer Centers	34,916,277	43,000,000	39,290,000	46,600,000	7,310,000
New Technologies	1,551,666	3,600,000	3,600,000	1,600,000	(2,000,000)
Total	**36,467,943**	**46,600,000**	**42,890,000**	**48,200,000**	**5,310,000**
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE					
NSFNET	6,454,750	6,500,000	6,353,000	9,365,000	3,012,000
Networking and Communications Research	2,104,005	4,400,000	3,500,000	4,000,000	500,000
Total	**8,558,755**	**10,900,000**	**9,853,000**	**13,365,000**	**3,512,000**
SUBTOTAL, CISE	**100,879,284**	**122,980,000**	**116,589,000**	**143,000,000**	**26,411,000**
REDUCTION FOR 1987 PAY SUPPLEMENTAL			(193,000)*		193,000
TOTAL, CISE	**$100,879,284**	**$122,980,000**	**$116,396,000**	**$143,000,000**	**$26,604,000**

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE
SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS					
INDUSTRIAL SCIENCE AND TECHNOLOGICAL INNOVATION					
Small Business Innovation Research	$14,944,147	$17,150,000	$16,779,000	19,412,500	$2,633,500
Productivity Improvement Research	279,763	0	0	0	0
Total	**15,223,910**	**17,150,000**	**16,779,000**	**19,412,500**	**2,633,500**
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES					
International Cooperative Science	9,479,140	11,960,000	9,582,000	11,264,000	1,682,000
International Scientific Organizations and Resources	742,863	700,000	700,000	700,000	0
Total	**10,222,003**	**12,660,000**	**10,282,000**	**11,964,000**	**1,682,000**
POLICY RESEARCH AND ANALYSIS					
Policy Research and Analysis	1,827,866	1,990,000	1,846,000	2,000,000	154,000
Total	**1,827,866**	**1,990,000**	**1,846,000**	**2,000,000**	**154,000**
SCIENCE RESOURCES STUDIES					
Scientific and Technical Personnel	2,102,036	1,840,000	2,022,000	2,669,500	647,500
Funding of Science and Technology	983,626	1,700,000	1,235,000	1,332,000	97,000
Modeling and Special Science and Technology Indicators	767,806	700,000	600,000	1,232,000	632,000
Total	**3,853,468**	**4,240,000**	**3,857,000**	**5,233,500**	**1,376,500**
RESEARCH INITIATION AND IMPROVEMENT					
Visiting Professorships for Women	2,081,521	2,000,000	2,000,000	2,500,000	500,000
Research Improvement in Minority Institutions	5,014,697	4,990,000	4,990,000	4,990,000	0
Minority Research Centers of Excellence	0	4,000,000	4,000,000	4,000,000	0
Research Career Opportunity Awards	0	0	0	900,000	900,000
Total	**7,096,218**	**10,990,000**	**10,990,000**	**12,390,000**	**1,400,000**
SUBTOTAL, STIA	**38,223,465**	**47,030,000**	**43,754,000**	**51,000,000**	**7,246,000**
REDUCTION FOR 1987 PAY SUPPLEMENTAL			(72,000)*		72,000
TOTAL, STIA	**$38,223,465**	**$47,030,000**	**$43,682,000**	**$51,000,000**	**$7,318,000**

*Amount to be transferred to the PD&M activity, upon approval of the requested increase in the FY 1987 PD&M Limitation, for cost increases resulting from the new Federal Retirement System and the 1987 government-wide pay adjustment.

LEVEL OF FUNDING BY PROGRAM - Continued

PROGRAM ELEMENT	ACTUAL FY 1986	REQUEST FY 1987	CURRENT PLAN FY 1987	ESTIMATE FY 1988	DIFFERENCE FY 1988/87
PROGRAM DEVELOPMENT AND MANAGEMENT					
Program Development and Management	71,836,106	78,000,000	79,100,000	95,000,000	15,900,000
Full-time Equivalent	1,124	1,174	1,174	1,204	
TOTAL, RESEARCH AND RELATED ACTIVITIES	*1,297,313,456*	*1,479,000,000*	*1,407,622,245*	*1,635,000,000*	*227,377,755*
Unobligated Balances and Other Adjustments	(3,253,456)		(1,472,245)		1,472,245
Research and Related Activities Appropriation	$1,294,060,000	$1,479,000,000	$1,406,150,000	$1,635,000,000	$228,850,000
U.S. ANTARCTIC RESEARCH PROGRAM					
U.S. Antarctic Research Program	$11,016,352	$12,000,000	$12,500,000	$13,500,000	$1,000,000
Total	*11,016,352*	*12,000,000*	*12,500,000*	*13,500,000*	*1,000,000*
OPERATIONS SUPPORT PROGRAM					
Science Support	$16,000,000	$16,100,000	$16,300,000	30,700,000	14,400,000
Logistics Support	70,044,459	59,700,000	59,080,617	61,600,000	2,519,383
Major Construction and Procurement	13,100,000	29,200,000	29,200,000	37,200,000	8,000,000
Total	*99,144,459*	*105,000,000*	*104,580,617*	*129,500,000*	*24,919,383*
TOTAL, U. S. ANTARCTIC PROGRAM	*110,160,811*	*117,000,000*	*117,080,617*	*143,000,000*	*25,919,383*
Unobligated Balance and Other Adjustments	(9,811)		(80,617)		80,617
U.S. Antarctic Program Appropriation	*$110,151,000*	*$117,000,000*	*$117,000,000*	*$143,000,000*	*$26,000,000*
SCIENCE AND ENGINEERING EDUCATION					
Teacher Preparation and Enhancement	$26,256,302	$27,000,000	$30,500,000	$36,000,000	$5,500,000
Materials Development, Research and Informal Science Education	24,356,300	25,000,000	29,525,000	0	(29,525,000)
Materials Development and Informal Science Education	0	0	0	26,000,000	26,000,000
College Science Instrumentation	5,259,080	7,500,000	9,500,000	9,500,000	0
Research Career Development	25,937,980	27,300,000	27,300,000	36,000,000	8,700,000
Studies and Program Assessment	2,785,179	2,200,000	2,210,693	0	(2,210,693)
Research, Studies and Program Assessment	0	0	0	7,500,000	7,500,000
Total, Science and Engineering Education	*84,594,841*	*89,000,000*	*99,035,693*	*115,000,000*	*15,964,307*
Unobligated Balance and Other Adjustments	(31,433,841)		(35,693)		35,693
Science and Engineering Education Activities Appropriation	*$53,161,000*	*$89,000,000*	*$99,000,000*	*$115,000,000*	*$16,000,000*
SPECIAL FOREIGN CURRENCY PROGRAM					
Special Foreign Currency Program	$1,098,263	$700,000	$725,187	0	($725,187)
Unobligated Balances and Other Adjustments	(141,263)		(25,187)		25,187
Special Foreign Currency Appropriation	*$957,000*	*$700,000*	*$700,000*	*0*	*($700,000)*
TOTAL, NSF APPROPRIATION	*$1,458,329,000*	*$1,685,700,000*	*$1,622,850,000*	*$1,893,000,000*	*$270,150,000*

ANALYSIS OF CHANGES IN OBLIGATION LEVELS: FY 1986 - FY 1988

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

	Obligations
FY 1986 Obligated Level	$1,297,313,456
FY 1987:	
Increases:	
Mathematical and Physical Sciences	28,066,917
Engineering	17,858,067
Biological, Behavioral and Social Sciences	18,422,153
Geosciences	17,722,507
Computer and Information Science and Engineering	15,516,716
Scientific, Technological and International Affairs	5,458,535
Program Development and Management	7,263,894
Subtotal	110,308,789
FY 1987 Obligated Level	$1,407,622,245
FY 1988:	
Increases:	
Mathematical and Physical Sciences	50,623,000
Engineering	42,235,000
Biological, Behavioral and Social Sciences	39,285,755
Geosciences	45,412,000
Computer and Information Science and Engineering	26,604,000
Scientific, Technological and International Affairs	7,318,000
Program Development and Management	15,900,000
Subtotal	227,377,755
FY 1988 Obligated Level	$1,635,000,000

U.S. ANTARCTIC ACTIVITIES APPROPRIATION

	Obligations
FY 1986 Obligated Level	$110,160,811
FY 1987:	
Increases:	
U.S. Antarctic Research Program	1,483,648
Operations Support	5,436,158
Subtotal	6,919,806
FY 1987 Obligated Level	$117,080,617
FY 1988:	
Increases:	
U.S. Antarctic Research Program	1,000,000
Operations Support	24,919,383
Subtotal	25,919,383
FY 1988 Obligated Level	$143,000,000

ANALYSIS OF CHANGES IN OBLIGATION LEVELS: FY 1986 - FY 1988, continued

SCIENCE AND ENGINEERING EDUCATION ACTIVITIES APPROPRIATION

	Obligations
FY 1986 Obligated Level	$84,594,841
FY 1987:	
Increases:	
Teacher Preparation and Enhancement	4,243,698
Materials Development and Informal Science Education	4,601,736
College Science Instrumentation	4,240,920
Research Career Development	1,362,020
Subtotal, Increases	14,448,374
Decrease:	
Research, Studies and Program Assessment	(7,522)
FY 1987 Obligated Level	$99,035,693
FY 1988:	
Increases:	
Teacher Preparation and Enhancement	5,500,000
Research Career Development	8,700,000
Research, Studies and Program Assessment	1,789,307
Subtotal, Increases	15,989,307
Decrease:	
Materials Development and Informal Science Education	(25,000)
FY 1988 Obligated Level	$115,000,000

SPECIAL FOREIGN CURRENCY APPROPRIATION

	Obligations
FY 1986 Obligated Level	$1,098,263
FY 1987:	
Decrease:	
Special Foreign Currency Program	(373,076)
FY 1987 Obligated Level	$725,187
FY 1988:	
Decrease:	
Special Foreign Currency Program	(725,187)
FY 1988 Obligated Level	$0

PERCENTAGE DISTRIBUTION OF TOTAL OBLIGATIONS: FY 1986 - FY 1988

	Actual FY 1986	Request FY 1987	Current Plan FY 1987	Estimate FY 1988
Research and Related Activities				
Mathematical and Physical Sciences	29.2%	29.1%	28.5%	27.2%
Engineering	9.7	10.2	10.0	10.8
Biological, Behavioral and Social Sciences	16.0	16.1	15.8	15.7
Geosciences	17.9	17.7	17.5	17.4
Computer and Information Science and Engineering	6.8	7.3	7.2	7.6
Scientific, Technological and International Affairs	2.6	2.8	2.7	2.7
Program Development and Management	4.8	4.6	4.9	5.0
Subtotal, Research and Related Activities	**87.0**	**87.8**	**86.6**	**86.4**
U.S. Antarctic Program				
U.S. Antarctic Research Program	0.7	0.7	0.8	0.7
Operations Support Program	6.6	6.2	6.4	6.8
Subtotal, U.S. Antarctic Program	**7.3**	**6.9**	**7.2**	**7.5**
Science and Engineering Education				
Teacher Preparation and Enhancement	1.8	1.6	1.9	1.9
Materials Development and Informal Science Education	1.4	1.3	1.6	1.4
College Science Instrumentation	0.3	0.5	0.6	0.5
Research Career Development	1.7	1.6	1.7	1.9
Research, Studies and Program Assessment	0.4	0.3	0.4	0.4
Subtotal, Science and Engineering Education	**5.6**	**5.3**	**6.2**	**6.1**
Special Foreign Currency	0.1	—	—	—
TOTAL, NSF	**100.0%**	**100.0%**	**100.0%**	**100.0%**

SUMMARY OF OBLIGATIONS BY MAJOR OBJECT CLASSIFICATION

	Actual FY 1986	Request FY 1987	Current Plan FY 1987	Estimate FY 1988	Difference FY 1988
Research and Related Activities					
Personnel and Compensation	$47,137,864	$47,665,000	$49,070,000	$52,955,000	$3,885,000
Personnel Benefits	5,355,290	5,155,000	6,350,000	9,325,000	2,975,000
Travel and Transportation of Persons	2,607,747	3,500,000	3,500,000	3,799,000	299,000
Transportation of Things	216,423	245,000	225,000	251,000	26,000
Rents and Communications	7,668,819	10,735,000	9,700,000	13,280,000	3,580,000
Printing and Reproduction	575,154	420,000	535,000	535,000	0
Other Contractual Services:					
Program Contracts	153,184,602	184,389,000	166,062,000	191,960,000	25,898,000
Prog. Devel. & Mgt. Contract Services	3,948,390	5,611,000	5,145,000	6,540,000	1,395,000
Supplies and Materials	639,578	959,000	830,000	1,000,000	170,000
Equipment	3,662,766	3,660,000	3,715,000	7,285,000	3,570,000
Grants, Subsidies and Contributions:					
Program Grants	1,072,292,748	1,216,611,000	1,162,460,245	1,348,040,000	185,579,755
Program Development and Management Grants	24,065	30,000	30,000	30,000	0
Subtotal, Research and Related Activities	**1,297,313,456**	**1,479,000,000**	**1,407,622,245**	**1,635,000,000**	**227,377,755**
U. S. Antarctic Program					
Program Contracts	98,322,811	106,125,000	104,550,617	128,000,000	23,449,383
Program Grants	11,838,000	10,875,000	12,530,000	15,000,000	2,470,000
Subtotal, U.S. Antarctic Program	**110,160,811**	**117,000,000**	**117,080,617**	**143,000,000**	**25,919,383**
Science and Engineering Education					
Program Contracts	3,395,000	2,700,000	3,961,000	5,000,000	1,039,000
Program Grants	81,199,841	86,300,000	95,074,693	110,000,000	14,925,307
Subtotal, Science and Engineering Education	**84,594,841**	**89,000,000**	**99,035,693**	**115,000,000**	**15,964,307**
Special Foreign Currency					
Travel and Transportation of Persons	64,000	40,000	40,000	0	(40,000)
Program Contracts	58,000	80,000	35,000	0	(35,000)
Program Grants	976,263	580,000	650,187	0	(650,187)
Subtotal, Special Foreign Currency	**1,098,263**	**700,000**	**725,187**	**0**	**(725,187)**
TOTAL, NSF	**$1,493,167,371**	**$1,685,700,000**	**$1,624,463,742**	**$1,893,000,000**	**$268,536,258**

NSF APPROPRIATION LANGUAGE

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), [title IX of the National Defense Education Act of 1958 (42 U.S.C.1876-1879),] and the Act to establish a National Medal of Science (42 U.S.C.1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of one aircraft; hire of passenger motor vehicles; not to exceed [$2,500] *$6,000* for official reception and representation expenses; uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901-5902); rental of conference rooms in the District of Columbia; and reimbursement of the General Services Administration for security guard services; [$1,406,150,000] *$1,635-,000,000*, to remain available until September 30, [1988] *1989*: *Provided*, [That of the funds appropriated in this Act, not more than $85,060,000 shall be available for astronomical sciences: *Provided further*, That of the funds appropriated in this Act, or from funds appropriated previously to the Foundation, not more than $76,500,000 shall be available for program development and management in fiscal year 1987: *Provided further*,] That contracts may be entered into under the program development and management [limitation] *activity* in fiscal year: [1987] *1988* for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year: *Provided further*, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation: *Provided further*, That to the extent that the amount appropriated is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally. *(Additional authorizing legislation to be proposed.)*

(Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.)

NSF APPROPRIATION LANGUAGE, continued

UNITED STATES ANTARCTIC PROGRAM ACTIVITIES

For necessary expenses in carrying out the research and operational support for the United States Antarctic Program pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); maintenance and operation of aircraft and purchase of flight services for research and operations support; maintenance and operation of research ships and charter or lease of ships for research and operations support; hire of passenger motor vehicles; not to exceed [$1,000] *$1,500* for official reception and representation expenses [$117,000,000] *$143,000,000*, to remain available until expended: *Provided*, That receipts for support services and materials provided to individuals for non-Federal activities may be credited to this appropriation: *Provided further*, That no funds in this account shall be used for the purchase of aircraft. (*Additional authorizing legislation to be proposed.*)

(*Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.*)

NSF APPROPRIATION LANGUAGE, continued

SCIENCE AND ENGINEERING EDUCATION ACTIVITIES

For necessary expenses in carrying out science *and engineering* education programs and activities pursuant to the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including award of graduate fellowships, services as authorized by 5 U.S.C. 3109, and rental of conference rooms in the District of Columbia, [$99,000,000] *$115,000,000*, to remain available until September 30, [1988] *1989*: *Provided*, That to the extent that the amount of this appropriation is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally. *(Additional authorizing legislation to be proposed.)*

(*Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.*)

[SCIENTIFIC ACTIVITIES OVERSEAS (SPECIAL FOREIGN CURRENCY PROGRAM)]

[For payments in foreign currencies which the Treasury Department determines to be excess to the normal requirements of the United States, for scientific activities, as authorized by law $700,000, to remain available until September 30, 1988: *Provided*, That this appropriation shall be available in addition to other appropriations to the National Science Foundation for payments in the foregoing currencies.]

(Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.)

XIII. MINORITY VIEWS ON NATIONAL SCIENCE FOUNDATION FY 1988 AUTHORIZATION—H.R. 2330

While we support the overall authorization level in H.R. 2330, we are concerned about a number of provisions that we believe could be detrimental to the nation's scientific enterprise.

We wholeheartedly support the Committee's approval of the President's request of $1.89 billion for the agency. We also agree with the Committee's decision to increase funding for the pre-college education programs that were held constant in an otherwise generous budget proposal.

However, we believe the Committee transfer into pre-college education was excessive because it came at the expense of the Antarctica program, which was cut by an unreasonably large amount. For this reason, we proposed an amendment that would have added $14.5 million to pre-college education by transferring only $5 million out of the Antarctica program.

We believe the Antarctica program cannot sustain the $25 million cut approved by the Committee because top-notch research cannot be conduted in the absence of suitable facilities and operational support. This is as true in Antarctica as it is on university campuses. For example, the Committee's cut in the Antarctica program will delay the rehabilitation and upgrading of NSF's LC-130 aircraft, limiting scientific operations. This is especially troubling now when the ozone expeditions are of such importance. NSF may have to make further cuts in the research Directorates to free up funds for the Antarctica program.

The Committee report questions NSF's need to operate and maintain its own research vessel, despite NSF's long experience with the limitations imposed by vessels that are designed to serve military as well as civilian purposes. We recommend that the Committee hold hearings to attempt to end the controversy over the icebreaker issue.

We strenuously object to the provisions in H.R. 2330 directing that some Engineering Research Centers and one Science and Technology Center explore topics of the Committee's choosing.

This sort of direction is an unwarranted departure from our traditional respect for merit review. This interference is particularly uncalled for in the case of the Engineering Research Centers (ERC) since the program has emphasized manufacturing research from its inception. Conservatively estimated, one-third of current ERC funding is spent on that topic. How can the Committee be sure other research topics, including some that have implications for manufacturing, should not now take precedence?

In micromanaging the ERC program, the Committee may be thwarting the will of American industry as well as university researchers. ERCs require significant industrial participation, which guarantees that the research conducted will have relevance to problems faced by industry. If manufacturing research is industry's greatest need that will be reflected in the proposals without Congressional meddling.

The earmark for the Science and Technology Center is even more disturbing. The Committee is giving direction to a program that does not yet exist, pre-empting the report NSF has requested from the National Academy of Sciences to help develop the program. Moreover, the Committee has designated the center for curriculum development—an area of research for which a center might not be appropriate. This contradicts the Committee's express desire to ensure that NSF does not over-commit its future budgets by establishing too many centers. Finally, even more than the ERC provision, the Science and Technology Center directive brings the Committee perilously close to earmarking projects for particular schools—a practice the Committee has resisted.

We recommend that the Committee undertake a thorough review of the NSF's policies for establishing and evaluating centers. The anticipated doubling of the NSF budget and the attendant management questions, and the growth of centers give this issue great urgency.

We hope the troubling sections of H.R. 2330 can be dealt with before this bill is enacted.

BOB WALKER.
HARRIS W. FAWELL.
MANUEL LUJAN, Jr.
RON PACKARD.
JACK BUECHNER.
SHERWOOD L. BOEHLERT.

XIV. ADDITIONAL VIEW—HON. MANUEL LUJAN, JR. (R-NM)—NEW DIRECTIONS FOR U.S.-LATIN AMERICAN COOPERATION IN SCIENCE AND TECHNOLOGY

During the decade of the sixties and the early seventies, many important programs for scientific and technological cooperation between U.S. and Latin American scientists were initiated. Some were under the mandate of the Alliance for Progress, others were funded by USAID, National Science Foundation, the Fulbright program, the Organization of American States, and other agencies both within and outside the U.S. Government. The impact on U.S.-Latin American scientific relations was significant, and many important scientific institutions in Latin America were created or strengthened through this effort. During the 1970's these programs declined, and most of the Latin American countries which had participated were pronounced "AID graduates," and became ineligible for AID funds. At the same time, political unrest caused many scientists to leave their countries, thereby affecting some of the best Latin American institutions as well as the economic stability and vitality of these countries.

The weakening of links in Science and Technology cooperation between these countries and the U.S. is believed to be adversely affecting the spirit of inter-American cooperation. However, in visits from senior Latin American scientists, particularly at the National Research Council, the situation in the Latin American universities and other scientific institutions appears significantly changed. Many believe that the decline in joint research programs, graduate and postgraduate training opportunities, and networking relationships are detrimental to the scientific advancement in the hemisphere.

The time is ripe to consider new approaches to science and technology collaboration, more appropriate to the changed climate, to the problems and technologies of the eighties, and to the new capability in some scientific fields of some of the Latin American countries which coincide with U.S. scientific interests.

For this reason, I offered language to the Committee's report on the NSF FY88 Authorization bill calling for an independent, interagency study of mechanisms for present and future cooperations in science and technology.

Furthermore, among the reasons commending a study of Science and Technology (S&T) cooperation in the Americas are:

> Several countries have recently elected democratic governments, and scientists who were working abroad for many years have returned to their home countries. Thus, both the opportunity for increased S&T collaboration and the trained personnel to engage in programs is greater than at any time since the mid 1960s when cooperation reached its peak.

Latin American scientists have expressed interest in strengthened S&T cooperation with the United States, although using different modes than were prevalent in the 1960s and 70s.

A number of countries are reorganizing their S&T systems and infrastructure, creating new counterpart organizations for planning, funding priority programs, and mechanisms for international cooperation. One of the frustrations of Latin American scientists in dealing with the United States is that there is no central source of information on possible U.S. opportunities nor is there a single policy-making body in the U.S. government empowered to address the problem of scientific interaction.

There are important areas of S&T which can produce mutual benefits to the cooperating parties. Examples are seismic studies and prediction of earthquakes, tropical ecosystems, tropical diseases, the influence of El Nino on weather patterns in both the Northern and Southern Hemispheres, and techno-economics of alcohol fuels.

The forthcoming 500th anniversary of the Columbus voyages may provide an opportunity for new initiatives.

Currently, there are independent efforts pursuing mechanisms for U.S.-Latin American S&T cooperation. For example, a report entitled "Inter-American Cooperation in Space, Science and Technology" was prepared in response to an amendment I offered to the FY86-87 Foreign Relations Authorization Act (P.L. 99-93). This Department of State study surveyed past programs, but stopped short of recommending new actions for scientific interaction, though the provision asked for such recommendations.

In September 1986, Presidents Jose Sarney and Ronald Reagan agreed to undertake a special initiative for implementation of the existing U.S.-Brazil Agreement of Cooperation in S&T. Establishment of a high-level panel was agreed to, composed of eminent scientists, engineers, and governmental authorities from each country to present recommendations and suggestions of topics for bilateral cooperation, focusing on selected priority areas of mutual strength and benefit. The bi-national panel will suggest procedures to encourage and facilitate engagement of the private sectors of their countries. Cooperative projects would be financed jointly through resources to be allocated for this purpose by both countries.

The U.S.-Brazil agreement follows the pattern of the U.S.-India bilateral program in S&T, managed by NSF, which began with an initiative between the Indian Prime Minister and the U.S. President.

Finally, NSF's role in the international scientific community is of premier importance to the Committee. I believe that NSF should be at the forefront of any recommendations coming from the scientific community.

MANUEL LUJAN, Jr.

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